

SOLUTIA - 195

Kenneth
Bardo/R5/USEPA/US
05/02/2005 02:35 PM

To deborah.l.roush@mvs02.usace.army.mil
cc
bcc

Subject Jefferson Barracks

Dear Ms. Roush - I spoke with you a few years back (Sept. 2000) regarding work that EPA was requiring Solutia (located in Sauget, IL) to perform in the Mississippi River. As a result of our investigations, Solutia installed a barrier wall and pumping wells to capture groundwater contaminants before they can discharge to the river at RM 178. EPA now wants to investigate the impacts to sediment from these historical discharges, in particular at Jefferson Barracks.

Based on the Corps September 1998 hydrographic survey map, we noticed that the Corps had constructed a dike field at Jefferson Barracks along the east bank of the Mississippi River from RM 170.9 to 168.5. As a result, a large area of sediment has been deposited within the dikefield. The dikefield is located approximately 7 to 9.5 miles downstream from the Solutia facility.

EPA is considering whether to undertake a sediment investigation and sampling program. If performed, it would likely consist of core samples taken along a transect within the Corps dikefield. Additional samples at Arsenal Island (RM 175) and upstream of the Solutia facility (RM 178) would also be considered.

EPA and its contractor would like to meet with the Corps in St. Louis to further discuss this potential sampling program and share any pertinent information to properly coordinate the investigation. Any investigation would likely not occur until expected low river flow in September or October of 2005. I can be reached at (312) 886-7566; e-mail is bardo.kenneth@epa.gov. Thank you for your time. Sincerely,
Ken Bardo

SOLUTIA - 196

May 4, 2005

DE-9J

VIA E-MAIL AND CERTIFIED MAIL
RETURN RECEIPT REQUESTED

7001 0320 0006 1565 3508

Mr. Steven D. Smith
Solutia Inc.
P.O. Box 66760
St. Louis, MO 63166-6760

RE: EPA Comments on Solutia's CMS Response to Comments
Administrative Order on Consent
U.S. EPA Docket No. R8H-5-00-003

Dear Mr. Smith:

We have completed a review of the *RCRA Corrective Measures Study (CMS) Response to Comments* (CMS RTC) submitted on February 9, 2005. The CMS RTC was submitted to address EPA's November 18, 2004, letter which stated that Solutia's final corrective measures proposal and supporting information was inadequate, and requested supplemental information. The final corrective measures proposal is required by Paragraph VI.5 of the Administrative Order on Consent (AOC), EPA Docket No. R8H-5-00-003.

Enclosed are general and specific comments on the CMS RTC, and a request for supplemental information. Solutia must address the enclosed comments through the submittal of three stand-alone workplans for the in-situ thermal desorption (ISTD) treatability test, enhanced aerobic bioremediation treatability test, and plume stability monitoring program. The treatability test workplans are due 30 days from receipt of this letter and the monitoring plan is due 60 days from receipt of this letter.

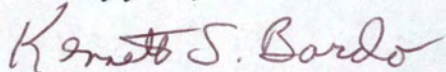
EPA does not require the preparation of a workplan to implement our request for supplemental information. Work to obtain the supplemental information should begin immediately upon receipt of this letter and be performed in a manner consistent with previous facility investigation work and the EPA Region 5 RCRA QAPP Policy. The information requested, all validated results, logs of all borings, and figures delineating all sample locations can be submitted as an Addendum to the August 27, 2004, CMS Report. The Addendum must be submitted to EPA by September 1, 2005.

EPA comments provided in our November 18, 2004, letter have not been fully addressed by Solutia in its Response to Comments. Some of these comments are reiterated in the Enclosure to this letter. Ultimately, all EPA comments provided in the November 18, 2004, letter must be

addressed by Solutia. This may be performed as part of the final CMS Report.

If you have any questions, please contact me at (312) 886-7566 or at bardo.kenneth@epa.gov.

Sincerely yours,



Kenneth S. Bardo, Project Manager
Corrective Action Section

cc: Jim Moore, IEPA
Gina Search, IEPA
Bruce Yare, Solutia (e-mail)

bcc: Richard Murawski, ORC
Nabil Fayoumi, EPA

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PS Form 3800, January 2001 (Reverse)

102595-01-M-1049

Enclosure

GENERAL COMMENTS

1. Bench-scale testing is proposed for only one technology (i.e., enhanced aerobic bioremediation) for soil and groundwater below the water table at the facility (i.e., deeper than 15 feet bgs). Source zones below 15 feet bgs at the Former Chlorobenzene Process Area consist of saturated finer silts and silty sands as deep as 35 feet bgs in the vicinity of boring DNAPL K-4. Enhanced aerobic bioremediation technology is probably not suitable for addressing this deeper silt and silty sand source zone, for the following reasons:
 - In areas where DNAPL is present, the concentration of MCB in the aqueous phase is, by definition, at the solubility limit (472 mg/l). However, the case studies presented in Table 4.1 of the Response to Comment (RTC) document were performed on groundwater with MCB concentrations ranging from 0.76 mg/l to 22 mg/l (i.e., less than five percent of the solubility limit). No data has been provided to indicate that aerobic bioremediation can be performed on chlorobenzene-contaminated groundwater at concentrations at or approaching solubility limits.
 - The silty soil in the upper portion of the shallow hydrogeologic unit (SHU) is likely to impede effective dispersion of the oxidizing reagent (e.g., gaseous oxygen). The presence of residual NAPL in pore spaces in this zone may also inhibit effective reagent dispersion. In addition, the extensive network of voids in the silty sand matrix discovered during the interim measures performed in response to the January 2001 spill may serve to further encourage migration of the oxidizing reagent through preferential pathways, rather than promote more uniform dispersion into the matrix.
 - Enhanced aerobic bioremediation occurs in the dissolved (aqueous) phase only, and relies upon the production of natural surfactants by the oxidizing bacteria to desorb contaminants from soil adsorption sites, reduce the viscosity of any free-phase NAPL, and lower interfacial tension that traps NAPL globules within the pore spaces of the soil matrix by capillary action. The production of these surfactants, and subsequent mass transfer of contaminants into the aqueous phase, can be rate-limited by the amount of NAPL present.¹ In addition, whether the requisite microbial species can survive and flourish in zones of very high contaminant concentrations, such as DNAPL-impacted areas, to promote and support bioremediation is a topic of current controversy in the industry that, to our knowledge, has not been resolved.² Thus, any

¹Lenzo, F., "Reactive Zone Remediation," in *In-Situ Treatment Technology, Second Edition*, Lewis Publishers, 2001, p.386.

²Sims, J.L., J.M. Suflita, and H.H. Russell, "EPA Groundwater Issue: In-Situ Bioremediation of Contaminated Groundwater," EPA/540/S-92/003, February 1992, p.9.

efforts to test and/or apply this technology in the DNAPL-impacted portion of the SHU at the facility would have to be preceded by sufficient literature review and/or laboratory testing to demonstrate that toxicity effects on the necessary bacteria are either absent or inconsequential.

During our meeting of February 23, 2005, Dr. Ralph Baker of TerraTherm indicated that in-situ thermal desorption (ISTD) technology should be capable of effectively remediating zones containing DNAPL, provided that the hydraulic conductivities are 10^{-3} centimeters per second (cm/s) to 10^{-4} cm/s or less.³ A slug test of piezometer TRA1-PZBSHU, upgradient of the Former Chlorobenzene Process Area (i.e., in the recharge area), indicated a hydraulic conductivity of approximately 1.3×10^{-4} cm/s. Moreover, as indicated on geologic cross-sections A-A' and B-B' of the facility⁴, the predominant soil types within the upper 15 to 20 feet of the SHU at the Former Chlorobenzene Process Area are silty sand and sandy silt, with occasional clay stringers. Therefore, upon initial review, it does not appear that the testing and potential implementation of the ISTD technology in the upper portion of the SHU would be limited by hydraulic conductivity concerns.

The current proposal is to target bench-scale testing of the ISTD technology for MCB and DCB above the water table (i.e., 15 feet bgs and shallower) in the Former Chlorobenzene Process Area. Dr. Baker indicated that the relative additional capital and operation and maintenance (O&M) costs associated with extending the thermal heating and vapor extraction wells an additional 10 to 15 feet into the saturated upper portion of the SHU would not be excessive. Moreover, pilot testing performed at the Eastland Woolen Mill (Eastland Woolen) Superfund Site in Corrina, Maine, indicated that the ISTD technology can effectively treat chlorobenzenes in partially saturated sediments. Given this information and the scarcity of available technologies potentially applicable to this source zone, expand the proposed bench-scale testing program to include the ISTD technology for the upper portion of the SHU.

Implement the following modifications to the proposed bench-scale testing procedures outlined in the RTC document for soil in the SHU that contains significant amounts of DNAPL:

- Conduct bench-scale testing for the ISTD technology as well as, or in place of, testing

³At higher hydraulic conductivities, the resultant influx of groundwater both makes implementation of the ISTD technology cost-prohibitive due to excess steam production and energy usage and/or precludes attainment of target temperatures for the contaminants of concern for the same reason.

⁴URS, "RCRA Corrective Measures Study (CMS) Addendum II, Solutia, Inc. W.G. Krummrich Facility" Drawing 2-1, October 2004.

of the enhanced aerobic bioremediation technology.

- Any bench-scale tests pertinent to the SHU should be conducted on bulk saturated soil/water samples collected from beneath the water table within the silty portion of the SHU at the Former Chlorobenzene Process Area (i.e., between approximately 15 feet bgs and 35 feet bgs, depending on location). Samples should also be collected from the most impacted locations and depth intervals as indicated by the 2004 DNAPL investigation findings discussed in the CMS Report. Present the proposed bench-scale test sampling locations in the workplan submitted to EPA for review and concurrence prior to proceeding with the testing program.
2. Krieking is proposed for delineating the boundaries of DNAPL-impacted areas, *in lieu* of additional field sampling. There is no objection to using krieking as a component of the DNAPL delineation strategy. However, it should be recognized that it is an estimation tool with inherent limitations and the following procedures should be implemented:
- In the meeting with EPA held on February 23, 2005, Mr. Bruce Yare of Solutia indicated that krieking is a useful tool for identifying potential locations of interest for additional sampling, based on the sampling data collected thus far. Thus, krieking should be used at the W.G. Krummrich facility to aid in placement of additional, focused soil borings and monitoring wells at locations necessary to delineate the three-dimensional extent of DNAPL impacts. Present the proposed location and sampling of these additional borings and wells in the workplan for EPA's review and concurrence.
 - At sites where krieking has been used to aid in DNAPL delineation (e.g., Pad 34 at Cape Canaveral, Florida), a customary practice has been to define up front the allowable standard error for the krieking calculations. Values generated by the computer model outside the acceptable error range can then be rejected as unreliable based on the existing data set. At Pad 34, a confidence interval of 80 percent was established for the krieking calculations. Propose the standard error value or confidence interval Solutia intends to employ to reject outlying data from krieking.
3. There appears to be some discrepancy in the treatability test discussion with regard to the length of time target temperatures will be maintained. In the discussion of test objectives (page 2-4), the RTC document indicates that, "each target temperature will be maintained for 72 hours to simulate the minimum treatment level associated with each target temperature." In the discussion of the testing process (page 2-6) however, the RTC document indicates that, "once the *furnace* has achieved the target treatment temperature, thermal treatment will be conducted for the specified residence time (72 hours) or until the soil sample thermocouple reaches the target treatment temperature." Based on this statement, it appears that the soil samples themselves will not be maintained at the target treatment temperature for the full 72 hour test period. If the soil samples are intended to

undergo the same treatment to be conducted in situ, and if the target temperatures are intended to reflect temperatures between the heater/vacuum wells, it would seem that the 72-hour residence time should not begin until the soil samples themselves reach the target temperatures.

Furthermore, Section 3.3 of the RTC document states that during bench-scale tests of the ISTD technology, the soil samples will be heated for a period of 72 hours. We are not aware of any specific standards, regulations, or guidelines that specify or recommend testing intervals or protocols for determining those intervals. Provide the rationale for a testing interval of 72 hours in the workplan.

In addition, Section 3.3 states the following:

"Once the furnace has achieved the target treatment temperature, thermal treatment will be conducted for the specified residence time (72 hours) or until the soil sample thermocouple reaches the target treatment temperature."

Clarify why this procedure is preferable to the alternative of running the test for 72 hours *once the soil sample thermocouple* achieves the target temperature (i.e., so that one can be confident the entire sample volume is being heated to the target temperature). Also provide a discussion of the comparability of test results for samples undergoing the full 72-hour treatment period to those for which the treatment period is terminated early based on soil sample thermocouple readings.

4. According to the proposed test plan in the RTC document, soil samples collected for treatability testing will be homogenized and blended. In addition, any large or agglomerated particles will be broken into smaller, more manageable sizes. It is unclear how this sample preparation process will impact treatability test results. In the workplan, provide a discussion on how many soil samples will be tested, the conditions under which homogenization will occur, the potential impact that homogenization will have on the soil concentrations of volatile constituents, moisture content and other factors. In addition, include a description of the locations where the soil samples should be collected, to ensure the samples are collected from the most contaminated area. In order to ensure the bench-scale tests are fully representative of in-situ soil conditions, consider collecting and analyzing field duplicate samples that are minimally disturbed (i.e., not homogenized) to aid in assessing any changes in contaminant concentrations, DNAPL content, and moisture content potentially occurring as a result of the homogenization process.
5. Under each of the arrays, consider adding an extra sample aliquot to be analyzed as a duplicate prior to the treatment. Mechanical homogenization does not ensure identical aliquots when dealing with inherent soil heterogeneity and less than 0.03 cubic feet of test samples. Results from the duplicate analyses could help verify the effectiveness of homogenization and provide the total (i.e., sampling and analytical) imprecision for the

bench scale test. This imprecision could help evaluate whether differences in performance between test aliquots were due to the variable being tested (e.g., temperature) or just the acceptable level of imprecision.

6. For the ISTD arrays, consider and discuss the impact of the injected heat that may occur during the field pilot test. Factors that should be considered in this discussion include:
 - The downward heat direction into the soil from the ISTD;
 - The groundwater immediately below 15 feet, and increased vapor pressure due to applied vacuum; and
 - The possibility that conductive heat will just continue to boil off groundwater, produce steam, and prevent the unsaturated zone to be heated beyond the water boiling point.

Moisture is a significant factor in the success of ISTD. The bench scale test using a sample of unsaturated zone material can boil off the fixed amount of moisture in the test sample. However, in the field, moisture will have an infinite source due to heating at the interface of the shallow groundwater and the unsaturated zone.

7. It is unclear why two different analytical methods were proposed for the analysis of MCB and DCB in the soil samples for the ISTD and enhanced aerobic bioremediation. Section 3.3 indicates that the MCB and DCB will be analyzed using SW-846 Method 8021B and Section 4.3 cites SW-846 Method 8260B. Method 8021B is the analysis for Aromatic and Halogenated Volatiles by Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors. Method 8260B is the analysis for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC-MS). SW-846 Method 8260B is a more definitive analytical technique (both qualitatively and quantitatively) that allows tentative identification/quantitation of non-target analytes. Provide the rationale for the different analytical methods. In addition, Section 3.3 indicates that a modified SW-846 Method 8021B will be used. Provide information regarding how this method will be modified.

Consider including an SVOC analysis on the PCB soil aliquot to determine pre- and post-treatment concentrations of other SVOCs such as 3,3'-dichlorobenzidine (boiling point [b.p.] 368 °C), or its breakdown product, benzidine (b.p. 402 °C). This compound (3,3'-dichlorobenzidine) was detected in the Former PCB Storage Area (Table 5.3 of the CMS Report).

8. Tables in Sections 2.1 and 3.1 identify the contaminant mass and soil volumes to be treated. Site contaminants include MCB, DCBs, and PCBs, their weathered forms and degradation products, as well as other contaminants as shown in Table 5.3 of the CMS. It is our understanding that Solutia will evaluate the treatability test by comparing only the concentrations of MCB, DCBs, and PCBs detected by SW-846 8021B and/or SW-846

8260B in the soil aliquots before and after the heat treatments. This may be misleading because some of the contaminants, and their weathered forms and degradation products, are not target analytes of methods SW-846 8021B and SW-846 8260B and are not required to be reported by the laboratory.

Consider including an analysis for total organic carbon (TOC) as an empirical measure of removal efficiency. TOC is an inexpensive analysis that can estimate removal efficiency based on simple organic carbon balance. An example calculation based on the results is provided as:

$$\text{TOC (total)} = \text{TOC (naturally occurring in soil)} + \text{TOC (contaminants)}$$

$$\text{Percent Removal} = \left(1 - \frac{\text{TOC}(\text{posttreatment})}{\text{TOC}(\text{pretreatment})} \right) \times 100$$

A supplemental analysis for extractable organic halides (EOX) should also be considered. Like TOC, EOX analysis would provide an empirical measure of removal efficiency based on simple chloride balance. This of course assumes there are negligible amounts of organic iodine and bromine in the soil aliquots. An example calculation based on the results is provided as:

$$\text{Percent Removal} = \left(1 - \frac{\text{EOX}(\text{posttreatment})}{\text{EOX}(\text{pretreatment})} \right) \times 100$$

In summary, the percent treatment efficiency should not be based exclusively on the initial and final concentrations of MCB, DCBs, and PCBs because the proposed analytical methods may not detect and subsequently report other contaminants that are not listed target analytes under EPA Methods SW-846 8021B and SW-846 8260B.

SPECIFIC COMMENTS

Section 1.3.3, Response to Comments: This section (and Section 5.0) states that a new corrective measures array, designed to achieve the Illinois Tiered Approach to Corrective Action (TACO) cleanup criteria in fewer than 30 years, will be evaluated. Based on previous EPA comments and discussions with Solutia, the purpose of this new array is unclear. In our November 18, 2004 letter, EPA requested that Solutia, "further investigate more aggressive source treatment technologies and their potential to reduce the cleanup interval from over 100 years to dozens of years or less, before concluding that containment is the only feasible alternative." To our knowledge, there is no statutory, regulatory, or administrative requirement to complete cleanup within 30 years at the Solutia facility. Clarify the rationale for this corrective measures array and select and analyze an array that is both aggressive in terms of technology implementation but also has a reasonable probability of success using the information currently available.

Estimated costs are presented in this section for those corrective actions Solutia believes are necessary to achieve Illinois EPA's Tiered Approach to Corrective Action Objectives (TACO) criteria and Class I Groundwater Standards at source areas within the Krummrich plant process area. Some of these estimated costs appear to be inconsistent with previous CMS corrective action estimates. For example, according to the August 27, 2004, CMS Report, the proposed impermeable cap under Array 2 appears to cover roughly 72 acres at an approximate cost of \$14.9 million (M). However, this section of the RTC document suggests that only 30 acres of land could be capped for that price. This discrepancy cannot be resolved without additional cost breakdown detail. In addition, the volume and area estimates cannot be verified without a discussion of the assumptions used in their derivation. These issues should be addressed in the final CMS report.

Section 2.1, Mass Delineation: According to the table in this section, the volume of PCB-impacted soil above the high occupancy limit of 1 mg/kg in the Former PCB Manufacturing Area is estimated at 24,055 cubic yards (cy). The total volume of PCB-impacted soil throughout the plant process area is an estimated 250,710 cy. Provide additional information on the basis for these estimates. If the estimated volumes are based on output of the Environmental Visualization System modeling, as presented in Appendix A, specify the margin of error associated with the model. Although this information is of little concern for purposes of treatability testing, the size of potential volume errors and associated limitations on krieging should be more fully evaluated as part of remedy selection. Refer to General Comment No. 2.

Section 2.3, Treatability Test: Section 2.3 states that the focus of the Former PCB Manufacturing Area treatability test is to determine the target treatment temperatures needed to achieve a specific PCB concentration in the unsaturated soil and to demonstrate that PCBs are either volatilized or destroyed in situ by pyrolysis and/or oxidation. If so, the PCB treatability study should include indicators such as TOC and/or EOX analyses to measure contaminant removal by mass balance.

Section 2.3 indicates that total PCBs will be analyzed using SW-846 Method 8082. It is unclear whether total PCBs will be reported based on Aroclors only, or all congeners. Reporting total PCBs based on Aroclors only may result in an inaccurate measure of total PCB removal because weathered and non-Aroclor PCBs may be reported as non-detects, or not reported at all. On the other hand, reporting total PCBs by all congeners could add significant complications to the analytical methods. Consider using EPA Method 680, which identifies and reports PCBs as isomer groups or homologs (i.e., by level of chlorination); total PCB concentration in each sample is obtained by summing each isomer groups concentration. Furthermore, amounts and relative ratios of homologs can be used to identify a source and predict fate and transport because the degree of chlorination affects solubility, degradation, and transport.

Only total PCBs are proposed for chemical analysis. Other hazardous constituents such as benzene, chlorobenzene, 1,2-dichlorobenzene, ethylbenzene, toluene, xylenes, 1,2,4-trichlorobenzene, 4-nitrophenol, and 3,3'-dichlorobenzidine were also detected in soil at the Former PCB Manufacturing Area (see results for soil sample location S0802 in the CMS Report). In addition to PCBs, conduct a VOC and SVOC analysis of Aliquot 4 to determine all the hazardous constituents present. All hazardous constituents present in Aliquot 4 should also be analyzed for in Aliquots 1, 2, and 3 for each soil sample depth.

A bench-scale treatability test can be conducted without prior written approval from EPA, Region 5 provided that the test complies with the self-implementing requirements for R&D for PCB disposal provided in 40 C.F.R. 761.60(c). If the amount of material containing PCBs treated annually exceeds 70 cu. ft. of non-liquid PCBs and exceeds a maximum concentration of 10,000 ppm PCBs, Region 5 written approval is required. If necessary, we will forward the procedures for written approval to Solutia.

Section 3.1, Mass Delineation: According to the table in this section, the volume of MCB-impacted soil above 1 mg/kg in the Former Chlorobenzene Process Area is estimated at 56,184 cy. The total volume of MCB-impacted soil throughout the plant process area is an estimated 138,010 cy. Provide additional information on the basis for these estimates. If the estimated volumes are based on output of the Environmental Visualization System modeling, as presented in Appendix A, specify the margin of error associated with the model. Although this information is of little concern for purposes of treatability testing, the size of potential volume errors and associated limitations on krieging should be more fully evaluated as part of remedy selection. Refer to General Comment No. 2.

Section 3.3, Treability Test: Treatability tests on soil samples from the vadose zone are proposed at temperatures of 150 °C, 200 °C, and 250 °C. Based on TerraTherm's experience at the Eastland Woolen site, Dr. Baker indicated that the primary and predominant mechanism for removal of chlorobenzenes from impacted soil was steam distillation, rather than direct evaporation. Therefore, the temperature range of greatest interest for treatability testing would be between the boiling point of water (100 °C) and the boiling point of chlorobenzene (132 °C) (note that the boiling points of di- and tri-chlorobenzenes are all greater than 132 °C). In

addition, the case history summary of the Eastland Woolen site⁵ indicates that vaporization and removal of chlorobenzene begins to occur at the eutectic temperature of an azeotropic chlorobenzene-water mixture (90.2 °C). Therefore, treatability tests on both the vadose zone samples and on soil samples collected beneath the water table should include test aliquots at a temperature of approximately 100 °C and 132 °C.

Only MCB and DCB are proposed for chemical analysis. Other hazardous constituents such as benzene, ethylbenzene, toluene, xylenes, tetrachloroethene, MEK, MIBK, trichloroethene, cis-1,2-dichloroethene, PAHs, 1,2,4-trichlorobenzene, 2- and 4-nitrochlorobenzene, 1-chloro-2,4-dinitrobenzene, 3,4-dinitrochlorobenzene, pentachlorophenol, 2,4,5- and 2,4,6-trichlorophenol, p-chloroaniline, n-nitrosodiphenylamine, 2,4-dichlorophenol, 2-chlorophenol, carbazole, and dibenzofuran were detected in soil at the Former Chlorobenzene Process Area (see results for soil sample locations S1207, S1208, S1210, S1211, and S1212 in the CMS Report). Conduct a VOC and SVOC analysis of Aliquot 4 to determine all the hazardous constituents present, in addition to MCB and DCB. All hazardous constituents present in Aliquot 4 should also be analyzed for in Aliquots 1, 2, and 3 for each soil sample depth.

Section 4.2.2, Technology Comparison: DNAPLs exist at the site in all three hydrogeologic units (see CMS Report, Figure 5.3.5). The SHU has significantly different hydrogeologic properties (e.g., hydraulic conductivity and transmissivity) than the middle hydrogeologic unit (MHU) and deep hydrogeologic unit (DHU) (Section 2.4 of the CMS Report). The workplan should clearly explain and evaluate the applicability of the technologies at the different hydrogeologic units separately.

Section 4.3, Treatability Test: The text states that aquifer conditions will be simulated through the use of a large diameter column. Specify if separate tests will be conducted for the SHU and the MHU/DHU, which have very different hydrogeologic characteristics.

According to the text, the flow rates during the treatability tests will be set at a rate equivalent to the groundwater velocity in the MHU and DHU. A significant portion of DNAPL exists within the SHU, and excluding the SHU will leave a significant portion of DNAPL untreated. Include the saturated portion of the SHU (i.e., silty soils at 15 to 35' bgs at the Former Chlorobenzene Process Area) in the treatability testing.

Consider designating an aliquot to be used as the control (i.e., without oxygen-saturated water flowing through it). Provide a discussion regarding how temperature and light will be controlled during the microcosm studies to closely simulate the aquifer conditions.

⁵Baker, R.S., R.J. Bukowski, and H. McLaughlin, "Pilot-Scale Demonstration of In-Pile Thermal Destruction of Chlorobenzene-Contaminated Soil," in *Physical and Thermal Technologies: Remediation of Chlorinated and Recalcitrant Compounds*, Batelle Press, 2002, p.3.

Distilled or deionized water, instead of actual aquifer water, is proposed to be added to the column. Examples of treatability studies included in Appendix B used actual groundwater. Even though bicarbonate will be added to adjust alkalinity, other naturally occurring groundwater elements and minerals (e.g., nitrates, sulfides, dissolved metals, chlorides, sodium) could effect the aquifer's geochemistry and bioremediation processes. Use site water if possible or in the alternative, use distilled or deionized water that is adjusted to mimic site water in elements and minerals.

The treatability studies do not include discussion on potential biomass buildup. Since MCB and DCBs serve as a growth substrate, the microcosm study should consider evaluating potential biomass buildup which could limit the growth and spread of healthy microbial colonies and cause plugging of soil pores. Consider evaluating the extent of biomass buildup in one of the aliquots since this would potentially impact sustained and continuous microbial degradation.

The text states that changes in aqueous phase MCB/DCB concentrations will be monitored in the effluent. The test should not only monitor the dissolved phase concentrations but also measure the amount of source mass within the simulated aquifer system before and after the completion of the treatability test.

MCB and DCBs are the proposed target compounds for the bench-scale treatability tests. This is appropriate, given that these were the principal constituents released at the Former Chlorobenzene Process Area and also the constituents most commonly detected in terms of both location and magnitude during the DNAPL investigation and in the downgradient groundwater plume. However, there are additional contaminants of concern (COCs) that have been consistently detected at the Former Chlorobenzene Process Area and elsewhere on site, including trichlorobenzenes, chlorophenols (di-, tri-, and penta-), methylphenols, chloroanilines, nitroanilines, and nitrobenzene. Prior to performing the bench-scale tests, it is premature to conclude that treatment of MCB and/or DCBs will be the rate-limiting processes for DNAPL removal and groundwater remediation. In addition, final cleanup standards will need to be achieved for all COCs, and thus it is important to gauge the ability of the technologies being bench-tested to treat these COCs. Modify this discussion to indicate that all identified COCs will be analyzed for in pre-test and post-test samples. Subsequently, in the bench-scale test report(s), discuss which contaminants appear to be the rate-limiting processes for the particular technologies that were evaluated.

The bench-scale test of enhanced aerobic bioremediation will be performed using only one oxidant (i.e., gaseous oxygen). There is a limit on the amount of gaseous oxygen that can be incorporated into an aquifer (typically around 40 mg/l at normal ambient conditions).⁶ A dissolved oxygen concentration of 40 mg/l may be insufficient to promote aerobic biodegradation of high concentrations of dissolved organic contaminants, such as would be created when

⁶LaGrega, M.D., P.L. Buckingham, and J.C. Evans, *Hazardous Waste Management*, McGraw-Hill, Inc., 1994, p.597.

DNAPL is transferred into the aqueous phase by the action of natural surfactants released by the bacteria. By using alternate oxygen-generating substances, such as hydrogen peroxide or slow-release magnesium peroxide, markedly higher oxygen concentrations (i.e., on the order of several hundred parts per million) and/or a more consistent supply of dissolved oxygen to the aquifer can be attained. In addition, storage of these oxygen-supplying substances on site requires less space and potentially reduces the flammability protection measures that would have to be installed for oxygen bottles. Lastly, while one purpose of bench-scale testing is to affirm that one preferred technology or reagent is feasible, another important benefit is the ability to evaluate different reagents to aid in selecting the optimal substance for pilot-scale testing and potential full-scale implementation. Consider including the testing of enhanced aerobic bioremediation using several different oxygen-generating substances, such as hydrogen peroxide and oxygen release compound (ORC) (a slow-release magnesium peroxide formulation marketed by Regenesis, Inc.).

The current test procedures for the enhanced aerobic bioremediation bench-scale studies provide no means for evaluating the survivability and adaptability of key microbial colonies essential to these reactions. Amend the test procedures to include plate counts of the critical microbial populations (i.e., in colony-forming units) on both the untested soil samples and the microcosm samples for which the prescribed test periods tabulated on page 4-7 of the RTC document have been completed. Analyses for baseline organic carbon levels (i.e., TOC) and vital nutrients for the bioremediation processes (e.g., nitrogen and phosphorus) should also be performed in the liquid phase.

Figures 4.1 and 4.2: These figures do not indicate, to the same degree of detail, the locations and depths where the treatability samples for the DNAPL bench-scale study will be collected. Provide additional figures in the workplan that show the most probable locations and depths for collection of the treatability samples. As indicated for the vadose zone MCB/DCB and PCB treatability samples (Figures 2.1 and 2.2, and 3.1 through 3.4), the samples should be collected from the zones of greatest impact, if possible. Therefore, as discussed in General Comment No. 1 above, samples from the upper portion of the SHU that previously exhibited the highest concentrations of chlorobenzenes, and thus the greatest fraction of DNAPL, should be used for this testing program.

Section 5, Comparative Analysis of Corrective Measure Arrays: The corrective measure arrays listed in this section consist of two components, source control and downgradient groundwater migration control. Arrays 2 and 3 have been retained from the draft CMS Report dated August 27, 2004. If Solutia intends to retain these two arrays, they should address all comments that were submitted on various elements of the proposed arrays. Please refer to General Comment Nos. 4, 5, 7, 8, and 11 in EPA's comment letter dated November 18, 2004.

Array 3 has been modified from the one presented in the draft CMS Report to include aggressive source area groundwater extraction and treatment. The specific technologies for source area treatment to be evaluated as part of Array 3 are not listed. Solutia should indicate if the

technologies that are being tested in the treatability tests will be included in this array. Source area treatment options should be considered with and without groundwater extraction and treatment to evaluate the incremental gain achieved by including source area groundwater extraction and treatment in addition to ISTD or enhanced biodegradation.

As stated in EPA's General Comment No. 1 dated March 18, 2004, there is no requirement for including Array 4 for achievement of regulatory criteria in 30 years. However, Solutia may develop one array, limited to active source control measures with ISTD, along with institutional controls which includes the existing Site R slurry wall for groundwater migration control and monitoring. This array should be developed in addition to an array with more comprehensive active treatment for soil and groundwater contamination above the TACO criteria.

Section 6.1: Table 6.1 provides the proposed screen elevations for monitoring wells MW #1 to #17. Proposed screen elevations for these monitoring wells are:

MW #4, 5, 6, 7, 10, 11, 12, 14, 15, and 16 = 270' to 275'

MW #17 = 285' to 290'

MW #9 and 13 = 290' to 295'

MW #8 = 305' to 310'

MW #1 and 3 = 330' to 335'

MW #2 = 345' to 350'

Comparing these elevations to the bedrock surface map (see Figure 4.3 of the CMS Report), most of the plume stability monitoring wells would be screened in bedrock which is present at 297' to 310' beneath the facility, and at 280' to 285' at the river. All wells should be screened above bedrock which is generally found at approximately 300' beneath the facility. Screen elevations in Table 6.1 need to be corrected and justification provided for the chosen screen elevations.

Monitoring wells are typically screened across the same hydrogeologic unit, e.g., the SHU at 380' to 395', MHU at 350' to 380', DHU at 300' to 350', or TOR at 280' to 310'. However, the proposed plan has wells screened at various elevations that are expected to straddle the highest MCB or DCB concentrations modeled using EVS software and the existing data set. Solutia needs to justify the chosen screen elevations and ensure that they are properly located in the most contaminated strata within the SHU, MHU, or DHU.

As noted in EPA's letter dated November 18, 2004, General Comment No. 2, there were several inconsistencies regarding the nature and extent of groundwater contamination in the draft CMS Report. Solutia should prepare and submit in the workplan, a clear description of the nature and extent of VOC and SVOC contamination in each hydrogeologic unit in order to support the proposed monitoring well locations and screen depths listed in Table 6.1. Also, MCB and DCB are not the only contaminants at all sample locations, as shown in Table 5.8 of the draft CMS Report. Solutia should consider all COCs above the screening value in the selection of monitoring wells and screen intervals.

In Figure 6.1, the location of Well #1 would appear to be affected by facility activities and not be reflective of background conditions. Consider locating the background well off-site. Also, Well #6 appears to be located in Site P. This well should be located out of the fill area and upgradient of Site P.

To ensure adequate coverage and proper monitoring of contaminant concentrations discharging to the Mississippi River that are not captured by the groundwater migration control system, include an additional monitoring well between well #15 and #16. Well #15 should be offset to the north to attain somewhat equal spacing of the wells at the rivers edge, if feasible.

Section 6.2: Clarify the sampling frequency discussed in this section. The wording appears to be inconsistent. EPA understands the proposed sampling program to be quarterly for the first two years, semiannually for the next three years, and annually thereafter. Sampling should not be conducted any less frequent than semiannually. Quarterly sampling may need to be performed longer than two years to develop appropriate statistics (e.g., decreasing, increasing, or stable trends).

In Table 6.3, update and provide data for piezometers GWE-11, -12, -13, -16, -17, -18, -19, -20, and -21.

In addition to the proposed groundwater elevation information to be obtained at the 23 existing piezometer clusters, obtain groundwater elevations at the 18 proposed monitoring well at the same time. Monitoring wells located near source areas should also be checked for NAPL prior to sampling.

Based on the CMS data for DHU wells, other hazardous constituents such as benzene, ethylbenzene, toluene, xylenes, 2-chlorophenol, 2,4-dichlorophenol, phenol, p-chloroaniline, and naphthalene are also present in deep groundwater. It would be preferable to analyze groundwater for all RCRA hazardous constituents (e.g., RCRA Appendix IX Ground-Water Monitoring List) to see what is present and then propose an analyte list based on that data.

The proposed laboratory analyses for monitored natural attenuation (MNA) does not include analyses for the degradation products of MCB and DCB, nor does it propose to conduct bacterial plate counts. In addition, the analytical methods are not specified. Knowing the concentration trends of the contaminants and degradation products will allow Solutia to verify whether decreasing MCB and DCB concentrations are due primarily to biodegradation, or other physical attenuation processes. Specifying the analytical methods ensures data comparability and consistent quality control requirements throughout the monitoring program. Solutia should use mass spectrometric methods that could provide identities of non-target compounds (SW846 Method 8260) and identify weathered PCBs (EPA Method 680). Bacterial plate counts can be added at the start or towards the end of the monitoring program to predict sustainable degradation process or explain steady state plume conditions.

The monitoring program does not include a discussion of field and groundwater parameters (i.e., pH, oxidation/reduction potential [ORP], specific conductance, or dissolved oxygen [DO]) to be measured during the groundwater sampling events. These geochemical data can be used to identify the type and sustainability of natural attenuation processes along the plume path. Solutia should consider including or clearly indicating that these field and groundwater parameters will be measured during sampling.

Section 6.3: It is unclear whether a statistical trend analysis will be performed on the plume boundary and transect wells. The workplan should clearly indicate whether concentration versus time plots will be prepared, and if trends will be evaluated visually or statistically.

Section 7.1: Based on the proposed schedule for source control evaluation, the ISTD treatability tests should be completed this summer. As we discussed, the ISTD treatability tests and subsequent pilot field tests should be fast-tracked. Therefore, consider separate schedules for the ISTD treatability tests and the in-situ bioremediation treatability tests, and consider stand-alone workplans and treatability test reports for each technology. The treatability test reports should discuss and propose a schedule for pilot-scale testing. A meeting can be held within two weeks of EPA's receipt of each treatability test report to discuss the path forward for pilot-scale testing.

The extent of PCB contamination at the Former PCB Manufacturing Area has not yet been fully delineated. The time frame for determining the full extent of PCB contamination should be considered in the required schedules.

The schedule does not discuss when the comparative analysis of corrective measure arrays (referenced in Section 5.0) will be completed and submitted to EPA. Currently, EPA and Solutia have discussed the use of interim measures to address source control. A focused interim corrective measures evaluation, with proposed full-scale implementation of applicable technologies, will be required upon completion of the treatability tests and pilot-scale tests. Appropriate technologies for addressing the identified source areas, such as ISTD, in-situ bioremediation, excavation/off-site disposal, and on-site containment should be evaluated. The time frame for completing the comparative analysis of final corrective measure arrays will be determined in the future based on the progress of the source control work and interim corrective measures to be performed.

Section 7.2: Submit a stand-alone workplan for the groundwater monitoring program that adequately addresses comments on Section 6 in this Enclosure and comments previously provided to Solutia in a letter dated December 3, 2004. Include an updated schedule for groundwater monitoring in the workplan.

Appendix C: Appendix C contains the calculations for the remediation time frame (RTF). It is not clear how the three degradation equations presented will be used to calculate the RTF in conjunction with the degradation rate to be calculated from the results of the microcosm studies. Please explain why step function and linear decay equations were presented.

SUPPLEMENTAL INFORMATION

Supplemental information requested by EPA in its November 18, 2004, letter is not fully addressed in Solutia's Response to Comments submitted on February 9, 2005. The supplemental investigations identified below are necessary to further characterize potential source areas and associated risks. The investigations must be performed this summer concurrently with the proposed treatability testing. All work must be performed in a manner consistent with previous work and the EPA Region 5 RCRA QAPP Policy. Provide the information requested, all validated results, logs of all borings, and figures delineating all sample locations as an Addendum to the CMS Report. The Addendum must be submitted to EPA by September 1, 2005.

Route 3 Drum Site - Additional detail is needed to document the interim action to determine what, if, any additional remedies are necessary. Characterization of groundwater in the vicinity of the Route 3 Drum Site is also needed to determine if the interim action is sufficient to protect human health and the environment.

Decomposing drums and associated wastes were excavated from the southwestern corner of Lot F in 1986 and 1987. Confirmation sampling completed after the excavation indicated that approximately 7,000 cubic yards of contaminated soil remained in the trench. In October 1987, a composite-compacted clay and high density polyethylene liner cap was installed over the trench. Provide the following additional detail:

- The results for any residual concentrations of all compounds of nitrochlorobenzene, dichloronitrobenzene, dinitrochlorobenzene, nitrobiphenyl, and any other contaminants exceeding applicable standards when capping was completed in this area.
- Section 7 of CMS Addendum II documents that 3500 drums of B-221 Ortho, 250 drums of Eutectic, and 585 drums of dinitrochlorobenzene were disposed at the drum site. Provide information on the hazardous constituents likely to be present in "B-221 Ortho" and "Eutectic".
- Any noticeable impacts on contaminant trends in groundwater for the constituents remaining in this area above applicable standards after capping.
- General procedures for and frequency of inspections and maintenance to ensure that cap integrity is not compromised.
- Verification that this capped area is encircled by the chain link fence mentioned in Section 5.2.1.2 of the CMS Report, and that the chain link fence encompasses the originally estimated soil impact area (meaning that the Phase II geophysical investigation and trenching was conducted outside the known Route 3 Drum Site

impact area).

- An indication as to how such inspection and maintenance efforts are funded. These activities and costs should be considered in the final corrective measures array analysis.

Monitoring wells GM-8, GM-31A, GM-31B, GM-31C, GM-54A, GM-54B, GM-58A, and GM-59A are located in the immediate vicinity of the Route 3 Drum Site. Historical data presented in Appendix F, Volume II of II, *Summary of Ground-Water Quality Conditions*, December 9, 1997, and graphs of water quality data presented in Figures E-6 and E-7 of the same report show significant concentrations of dinitrophenol, phenol, nitrobenzene, dinitrochlorobenzenes, nitrochlorobenzenes, and nitrobiphenyl in groundwater at GM-31A and to a lesser extent, at GM-58A. Both wells appear to monitor the water table at the Route 3 Drum Site. Redevelop the eight monitoring wells listed above, obtain groundwater samples, and analyze, at minimum for SVOCs and PCBs (PCBs were identified in soils during the partial cleanup of the Route 3 Drum Site). Include other constituent groups if warranted based on hazardous constituents expected to be present in "B-221 Ortho" and "Eutectic".

Provide a figure delineating the boundaries of the Route 3 Drum Site and location of each monitoring well sampled. Include individual constituent concentrations found in groundwater at each monitoring well sampled. Also confirm that the trench was excavated to 390' AMSL and provide the screened intervals for each monitoring well sampled.

Lot F - PCBs in surface soil (0-2') were detected in Lot F at sample locations S0205, S0206, and S0208. The PCB concentration in exposed surface soil at sample location S0205 (2.5 mg/kg) exceeds the TACO Tier 1 criteria for direct contact with soils of 1 mg/kg. PCBs were also detected nearby in soil during the 1986 cleanup at the Route 3 Drum Site. Further investigation is necessary in this area of Lot F to determine the areal extent of PCB contamination and associated human health and ecological risk in this area. Sample surface soil (0-2') and analyze for PCBs at the mid-point between soil sample locations S0205 and S0206, the midpoint between soil sample locations S0205 and S0208, and 100' both north and south of soil sample location S0205 (total of 4 samples).

At sample location S0110 in Lot F, 13.2 mg/kg of total PAHs were detected in exposed surface soil (0-2'). The boring log shows that a sand silty fill with brick and cinders was present at 1' to 2.5' beneath the surface one-foot of topsoil. The TACO Tier 1 criteria for direct contact with soils is exceeded for benzo(a) pyrene in this sample. Lead is also present in exposed surface soil (at 300 mg/kg) approaching the TACO Tier 1 criteria for direct contact with soils. Other sample locations in the area are 300' to 400' away. Further investigation is necessary to define the extent of this fill area and associated human health and ecological risk. Based on the July 4, 1940 aerial photo, sample location S0110 appears to be located in the middle of a large area of disturbed ground. Sample surface soil and analyze for SVOCs and total lead approximately 100' north, south, east, and west of soil sample location S0110, and also 200' north and south of soil sample

location S0110 (total of 6 samples). These suggested sampling locations are approximate and should be properly located to encounter fill likely present in this area.

The LF-series soil sample locations at the southwest corner of Lot F were sampled at 18 to 20-feet. VOCs (benzene, chlorobenzene, tetrachloroethene, dichloromethane, ethylbenzene, and xylene) were detected at LF-2, LF-3, and LF-4. SVOCs (1,2-dichlorobenzene, 2-methylnaphthalene, carbazole, n-nitrosodiphenylamine, and phenol) were also detected at LF-4. Table 5.4 shows that benzene, carbazole, n-nitrosodiphenylamine, and dichloromethane had concentrations at LF-4 that exceeded the TACO Tier 1 soil to groundwater leaching criteria. Aerial photos indicate past activity (e.g., surface impoundment, disturbed ground) in this area. Further investigation of this area is necessary to accurately determine the areal and vertical extent of the VOCs and SVOCs that exceed the TACO Tier 1 criteria for soil to groundwater leaching criteria. Describe whether the 18-20' sample depths were from the unsaturated zone. Sample deep soil (18-20') and analyze for VOCs and SVOCs 100' north, south, east, and west of soil sample location LF-4 (total of 4 samples).

Former Chlor-Alkali Production Area - Based on data from S-09-16, S-09-17, S-09-19, and S-09-20, there is an area identified at the Former Chlor-Alkali Production Area that exceeds TACO Tier 1 criteria for direct contact with soils for mercury. The areal extent of this contamination needs to be further defined east of S-09-16 between S-09-22 and S-09-23; west and south of S-09-17 between S-09-11 and S-09-12, and S-09-10 and S-09-11; and northwest of S-09-19 between S-09-13 and S-09-14. Furthermore, the deepest sample (7 to 10-feet) obtained at S-09-19, S-09-16, and S-09-20 exceeds the TACO Tier 1 criteria for direct contact with soils for mercury. Mercury contamination is present in the fill, clayey silt, and silty clay but is not defined in the deeper sand which was not encountered in the borings. Further investigation of this area is necessary to define the areal and vertical extent of mercury contamination exceeding either the TACO Tier 1 criteria for direct contact with soils or the soil to groundwater leaching criteria. Sample soil at depths of 2-3', 6-7', and 9-10' and analyze for mercury at the mid-point between soil sample locations S0910 and S0911, the midpoint between soil sample locations S0911 and S0912, the mid-point between soil sample locations S0913 and S0914, and the midpoint between soil sample locations S0922 and S0923 (total of 12 samples), and also at 13-15' at soil sample locations S0916, S0919, and S0920 (total of 3 samples).

PCBs in the Former Chlor-Alkali Production Area were detected at 13 and 5 ppm at soil sample locations S0904 and S0905, respectively. The PCBs are present in the fill which is 9 to 13-feet deep. Conduct additional sampling of the fill in this area to confirm whether PCB concentrations are consistently less than the 25 ppm screening criteria. Sample the fill (shallow or intermediate sample) and analyze for PCBs at S0902 (4-6'), S0903 (2-4'), S0906 (6-8'), S0907 (10-12'), S1003 (4-6'), S1004 (3-5'), and the mid-point between soil sample locations S0904 and S0905, the midpoint between soil sample locations S0904 and S0906, and the mid-point between S0905 and S0907 (total of 9 samples).

Soil Sample Location S0403 - A strong odor and elevated PID reading were noted in the boring

log for sample location S0403 but no VOCs or SVOCs were detected in the only soil sample taken (2-4'). No intermediate or deep sample was taken in sand where a strong odor, hydrocarbon odor, and elevated PID readings were noted. Resample this location at the 1-3' and 10-12' interval and analyze fill/soil for VOCs, SVOCs, pesticides/herbicides, and PCBs (total of 2 samples)

Soil Sample Locations S0408 and S0409 - Sample locations S0408 and S0409 identified an area (bounded by S0-4-23 to the east) where soils at an intermediate depth have elevated chlorobenzene, 1,3-dichloropropene, toluene, ethylbenzene, and xylene (VOC) concentrations. Aerial photographs indicate that this area was a tank farm from at least 1940 through the 1980's. Further investigation of this area is necessary to define the areal and vertical extent of VOCs that exceed either the TACO Tier 1 criteria for direct contact with soils or the soil to groundwater leaching criteria. Sample fill/soil 100' north, northeast, southwest, and west of soil sample location S0408 and analyze for VOCs (total of 4 samples). Probe and log to 15', and sample at the intermediate depth with the highest PID reading or most obviously contaminated.

Soil Sample Locations S1101, S1102, and S1103 - Soil sample locations S1101, S1102, and S1103 were used to investigate the eastern open area of the Solutia facility. The boring logs in CMS Addendum I show that fill is present at all three sample locations, varying from two to nine feet. However, no surficial samples were obtained to determine the potential risks associated with surface fill. Resample locations S1101, S1102, and S1103 and obtain shallow (0-2') samples and analyze for SVOCs (total of three samples).

MISSISSIPPI RIVER SEDIMENT CHARACTERIZATION

In recent meetings, EPA presented to Solutia, a hydrographic survey map generated by the U.S. Army Corps of Engineers (ACE) that depicts the depth to sediment in the Mississippi River in the vicinity of the Solutia facility. Two depositional areas located along the eastern-half of the river at Arsenal Island and Jefferson Barracks, approximately 4 and 8 miles downstream of the interim groundwater remedy, appear to be representative of hydraulic environments where contaminants from historical releases to the river may have migrated and accumulated in deep sediment.

Three grab samples of surficial sediment taken at Arsenal Island area during the October 2000, sampling event contained detectable concentrations of chlorobenzene, pentachlorophenol, toluene, and/or PAHs. Surface water at two locations at Arsenal Island detected benzene, chlorobenzene, 2-chlorophenol, 2,4-dichlorophenol, 4-chloroaniline, toluene, 2,4-D, and/or 2,4,5-T. EPA is not aware of any sampling performed further downstream at Jefferson Barracks, an area where ACE installed a dike field to promote sediment deposition.

EPA believes that sediment characterization is needed at Arsenal Island and Jefferson Barracks to determine whether site-related contaminants are present, including their vertical and horizontal extent, and whether they pose a potential risk in their current location or release during flood events. Solutia's position is that Mississippi River sediments have been adequately characterized by sampling events previously performed under RCRA and CERCLA authority. At this time, EPA continues to believe that supplemental investigations are warranted at Arsenal Island and Jefferson Barracks and is evaluating its options for addressing this potential data gap in the site investigations.

Section VI.5.b of the Administrative Order on Consent provides for EPA to request reasonable supplemental information from Solutia if its Final Corrective Measures Proposal and supporting information do not provide an adequate basis for selection of final corrective measures that must protect human health and the environment from the releases of hazardous waste or hazardous constituents at or from the facility. EPA reserves it right to request reasonable supplemental information in the form of chemical characterization and risk assessment of depositional areas of sediment in the Mississippi River downstream of the Solutia facility.

SOLUTIA - 197



May 27, 2005

Mr. Kenneth Bardo
U.S. EPA Region V
Corrective Action Section
Enforcement Compliance Branch
77 West Jackson Boulevard DE-J9
Chicago, IL 60604-3507

Re: Solutia Inc. – W. G. Krummrich Plant, RCRA

Dear Ken:

Enclosed are the Solutia responses to the agency's May 4th, 2005 comments. Also enclosed are the following two documents:

- In-Situ Thermal Desorption Work Plan
- Enhanced Aerobic Bioremediation Work Plan

We look forward to discussing these documents with you in the near future.

Sincerely,

A handwritten signature in black ink, appearing to read "Steve D. Smith", is written over a light blue horizontal line.

Steven D. Smith
Project Manager

cc: Distribution List on Following Page

Distribution List
May 27th, 2005 Response to Comments

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General Comment 1: Bench-scale testing is proposed for only one technology (i.e., enhanced aerobic bioremediation) for soil and groundwater below the water table at the facility (i.e., deeper than 15 feet bgs). Source zones below 15 feet bgs at the Former Chlorobenzene Process Area consist of saturated finer silts and silty sands as deep as 35 feet bgs in the vicinity of boring DNAPL K-4. Enhanced aerobic bioremediation technology is probably not suitable for addressing this deeper silt and silty sand source zone, for the following reasons:

- In areas where DNAPL is present, the concentration of MCB in the aqueous phase is, by definition, at the solubility limit (472 mg/l). However, the case studies presented in Table 4.1 of the Response to Comment (RTC) document were performed on groundwater with MCB concentrations ranging from 0.76 mg/l to 22 mg/l (i.e., less than five percent of the solubility limit). No data has been provided to indicate that aerobic bioremediation can be performed on chlorobenzene-contaminated groundwater at concentrations at or approaching solubility limits.
- The silty soil in the upper portion of the shallow hydrogeologic unit (SHU) is likely to impede effective dispersion of the oxidizing reagent (e.g., gaseous oxygen). The presence of residual NAPL in pore spaces in this zone may also inhibit effective reagent dispersion. In addition, the extensive network of voids in the silty sand matrix discovered during the interim measures performed in response to the January 2001 spill may serve to further encourage migration of the oxidizing reagent through preferential pathways, rather than promote more uniform dispersion into the matrix.
- Enhanced aerobic bioremediation occurs in the dissolved (aqueous) phase only, and relies upon the production of natural surfactants by the oxidizing bacteria to desorb contaminants from soil adsorption sites, reduce the viscosity of any free-phase NAPL, and lower interfacial tension that traps NAPL globules within the pore spaces of the soil matrix by capillary action. The production of these surfactants, and subsequent mass transfer of contaminants into the aqueous phase, can be rate-limited by the amount of NAPL present.¹ In addition, whether the requisite microbial species can survive and flourish in zones of very high contaminant concentrations, such as DNAPL-impacted areas, to promote and support bioremediation is a topic of current controversy in the industry that, to our knowledge, has not been resolved.² Thus, any efforts to test and/or apply this technology in the DNAPL-impacted portion of the SHU at the facility would have to be preceded by sufficient literature review and/or laboratory testing to demonstrate that toxicity effects on the necessary bacteria are either absent or inconsequential.

During our meeting of February 23, 2005, Dr. Ralph Baker of TerraTherm indicated that in-situ thermal desorption (ISTD) technology should be capable of effectively remediating zones containing DNAPL, provided that the hydraulic conductivities are 10^{-3} centimeters per second (cm/s) to 10^{-4} cm/s or less.³ A slug test of piezometer TRA1-PZBSHU, upgradient of the Former Chlorobenzene Process Area (i.e., in the recharge area), indicated a hydraulic conductivity of approximately 1.3×10^{-4} cm/s. Moreover, as indicated on geologic cross-sections A-A= and B-B= of the facility⁴, the predominant soil types within the upper 15 to 20 feet of the SHU at the Former Chlorobenzene Process Area are silty sand and sandy silt, with occasional clay stringers. Therefore, upon initial review, it does not appear that the testing and potential implementation of the ISTD technology in the upper portion of the SHU would be limited by hydraulic conductivity concerns.

The current proposal is to target bench-scale testing of the ISTD technology for MCB and DCB above the water table (i.e., 15 feet bgs and shallower) in the Former Chlorobenzene Process Area. Dr. Baker indicated that the relative additional capital and operation and maintenance (O&M) costs associated with extending the thermal

¹ Lenzo, F., "Reactive Zone Remediation," in *In-Situ Treatment Technology, Second Edition*, Lewis Publishers, 2001, p.386.

² Sims, J.L., J.M. Sullita, and H.H. Russell, "EPA Groundwater Issue: In-Situ Bioremediation of Contaminated Groundwater," EPA/540/S-92/003, February 1992, p.9.

³ At higher hydraulic conductivities, the resultant influx of groundwater both makes implementation of the ISTD technology cost-prohibitive due to excess steam production and energy usage and/or precludes attainment of target temperatures for the contaminants of concern for the same reason.

⁴ URS, "RCRA Corrective Measures Study (CMS) Addendum II, Solutia, Inc. W.G. Krummrich Facility" Drawing 2-1, October 2004.

heating and vapor extraction wells an additional 10 to 15 feet into the saturated upper portion of the SHU would not be excessive. Moreover, pilot testing performed at the Eastland Woolen Mill (Eastland Woolen) Superfund Site in Corrina, Maine, indicated that the ISTD technology can effectively treat chlorobenzenes in partially saturated sediments. Given this information and the scarcity of available technologies potentially applicable to this source zone, expand the proposed bench-scale testing program to include the ISTD technology for the upper portion of the SHU.

Implement the following modifications to the proposed bench-scale testing procedures outlined in the RTC document for soil in the SHU that contains significant amounts of DNAPL:

- Conduct bench-scale testing for the ISTD technology as well as, or in place of, testing of the enhanced aerobic bioremediation technology.
- Any bench-scale tests pertinent to the SHU should be conducted on bulk saturated soil/water samples collected from beneath the water table within the silty portion of the SHU at the Former Chlorobenzene Process Area (i.e., between approximately 15 feet bgs and 35 feet bgs, depending on location). Samples should also be collected from the most impacted locations and depth intervals as indicated by the 2004 DNAPL investigation findings discussed in the CMS Report. Present the proposed bench-scale test sampling locations in the workplan submitted to EPA for review and concurrence prior to proceeding with the testing program.

RESPONSE: In-situ thermal desorption (ISTD) treatability tests will be performed on soil samples from the unsaturated and saturated Shallow Hydrogeologic Unit (SHU). Enhanced aerobic bioremediation (EABR) treatability tests will be performed on soil samples from the saturated SHU. Soil samples will be collected from two depths (0 to 15 and 15 to 35 ft bgs) within the Former Chlorobenzene Process Area to provide samples for these treatability tests. Sampling locations will be given in the ISTD Treatability Test Work Plan and the EABR Treatability Test Work Plan.

General Comment 2: Kriegering is proposed for delineating the boundaries of DNAPL-impacted areas, *in lieu of* additional field sampling. There is no objection to using kriegering as a component of the DNAPL delineation strategy. However, it should be recognized that it is an estimation tool with inherent limitations and the following procedures should be implemented:

- In the meeting with EPA held on February 23, 2005, Mr. Bruce Yare of Solutia indicated that kriegering is a useful tool for identifying potential locations of interest for additional sampling, based on the sampling data collected thus far. Thus, kriegering should be used at the W.G. Krummrich facility to aid in placement of additional, focused soil borings and monitoring wells at locations necessary to delineate the three-dimensional extent of DNAPL impacts. Present the proposed location and sampling of these additional borings and wells in the workplan for EPA's review and concurrence.
- At sites where kriegering has been used to aid in DNAPL delineation (e.g., Pad 34 at Cape Canaveral, Florida), a customary practice has been to define up front the allowable standard error for the kriegering calculations. Values generated by the computer model outside the acceptable error range can then be rejected as unreliable based on the existing data set. At Pad 34, a confidence interval of 80 percent was established for the kriegering calculations. Propose the standard error value or confidence interval Solutia intends to employ to reject outlying data from kriegering.

RESPONSE: In the February 9, 2005 Response to Comments, kriegering was used to define the location and geometry of MCB and DCB DNAPL high mass areas in unsaturated and saturated soils in the plant process

area in order to select a location for collecting treatability study samples. Additional delineation of the DNAPL area boundaries is not needed to select these sampling locations. For that reason, a proposal for additional DNAPL borings and well and standard error values for kriging, are not proposed in this Response to Comments or in the In-Situ Thermal Desorption and Enhanced Aerobic Bioremediation Work Plans, which will be submitted separately.

General Comment 3: There appears to be some discrepancy in the treatability test discussion with regard to the length of time target temperatures will be maintained. In the discussion of test objectives (page 2-4), the RTC document indicates that, "each target temperature will be maintained for 72 hours to simulate the minimum treatment level associated with each target temperature." In the discussion of the testing process (page 2-6) however, the RTC document indicates that, "once the furnace has achieved the target treatment temperature, thermal treatment will be conducted for the specified residence time (72 hours) or until the soil sample thermocouple reaches the target treatment temperature." Based on this statement, it appears that the soil samples themselves will not be maintained at the target treatment temperature for the full 72 hour test period. If the soil samples are intended to undergo the same treatment to be conducted in situ, and if the target temperatures are intended to reflect temperatures between the heater/vacuum wells, it would seem that the 72-hour residence time should not begin until the soil samples themselves reach the target temperatures.

Furthermore, Section 3.3 of the RTC document states that during bench-scale tests of the ISTD technology, the soil samples will be heated for a period of 72 hours. We are not aware of any specific standards, regulations, or guidelines that specify or recommend testing intervals or protocols for determining those intervals. Provide the rationale for a testing interval of 72 hours in the workplan.

In addition, Section 3.3 states the following:

"Once the furnace has achieved the target treatment temperature, thermal treatment will be conducted for the specified residence time (72 hours) or until the soil sample thermocouple reaches the target treatment temperature."

Clarify why this procedure is preferable to the alternative of running the test for 72 hours *once the soil sample thermocouple* achieves the target temperature (i.e., so that one can be confident the entire sample volume is being heated to the target temperature). Also provide a discussion of the comparability of test results for samples undergoing the full 72-hour treatment period to those for which the treatment period is terminated early based on soil sample thermocouple readings.

RESPONSE: ISTD treatability test samples will be held at the target treatment temperature for 72 hours because TerraTherm's experience indicates that this time period represents the minimum length of time the coolest portion of the treatment zone will be at the target treatment temperature in a field-scale system.

General Comment 4: According to the proposed test plan in the RTC document, soil samples collected for treatability testing will be homogenized and blended. In addition, any large or agglomerated particles will be broken into smaller, more manageable sizes. It is unclear how this sample preparation process will impact treatability test results. In the workplan, provide a discussion on how many soil samples will be tested, the conditions under which homogenization will occur, the potential impact that homogenization will have on the soil concentrations of volatile constituents, moisture content and other factors. In addition, include a description of the locations where the soil samples should be collected, to ensure the samples are collected from the most contaminated area. In order to ensure the bench-scale tests are fully representative of in-situ soil conditions, consider collecting and analyzing field duplicate samples that are minimally disturbed (i.e., not homogenized) to aid in assessing any changes in contaminant concentrations, DNAPL content, and moisture content potentially

occurring as a result of the homogenization process.

RESPONSE: Soil samples will be homogenized in order to reduce heterogeneities in constituent concentrations. Homogenization will be conducted prior to loading treatability test vessels/columns, such that each test is conducted with constituents at similar initial concentrations. Without homogenization, heterogeneities among aliquots would further complicate analysis of results.

Homogenization of samples will be conducted immediately upon removing samples from preservation at 4°C. The homogenization process will be conducted as quickly as possible to minimize loss of volatile constituents. Immediately following homogenization, treatability test vessels/columns will be loaded with the homogenized soil and a sample of the homogenized soil will be submitted for laboratory analysis of VOCs by EPA 8260, SVOCs by EPA 8270, and PCBs by EPA 8082 (PCB testing will only be conducted for the sample collected at the Former PCB Manufacturing Area).

The number of soil samples to be collected for treatability testing is summarized on the following table:

Treatability Test	Area of Sample Collection	Geologic Unit	No. of Samples
ISTD	Former PCB Manufacturing Area	Unsaturated zone	1
ISTD	Former Chlorobenzene Process Area	Unsaturated zone	1
ISTD	Former Chlorobenzene Process Area	SHU	1
Bioremediation	Former Chlorobenzene Process Area	SHU	1
Bioremediation	Former Chlorobenzene Process Area	MHU/DHU	1
TOTAL NUMBER OF SOIL SAMPLES			5

Soil samples will be collected from the highest known concentration area within each geologic unit at the Former PCB Manufacturing Area and the Former Chlorobenzene Process Area.

General Comment 5: Under each of the arrays, consider adding an extra sample aliquot to be analyzed as a duplicate prior to the treatment. Mechanical homogenization does not ensure identical aliquots when dealing with inherent soil heterogeneity and less than 0.03 cubic feet of test samples. Results from the duplicate analyses could help verify the effectiveness of homogenization and provide the total (i.e., sampling and analytical) imprecision for the bench scale test. This imprecision could help evaluate whether differences in performance between test aliquots were due to the variable being tested (e.g., temperature) or just the acceptable level of imprecision.

RESPONSE: Following homogenization, a sample of untreated soil and a duplicate sample will be analyzed for VOCs by USEPA Method 8260B, SVOCs by USEPA Method 8270C, and PCBs by USEPA Method 680. PCB testing will only be conducted for the sample collected at the Former PCB Manufacturing Area.

General Comment 6: For the ISTD arrays, consider and discuss the impact of the injected heat that may occur during the field pilot test. Factors that should be considered in this discussion include:

- The downward heat direction into the soil from the ISTD;
- The groundwater immediately below 15 feet, and increased vapor pressure due to applied vacuum; and

- The possibility that conductive heat will just continue to boil off groundwater, produce steam, and prevent the unsaturated zone to be heated beyond the water boiling point.

Moisture is a significant factor in the success of ISTD. The bench scale test using a sample of unsaturated zone material can boil off the fixed amount of moisture in the test sample. However, in the field, moisture will have an infinite source due to heating at the interface of the shallow groundwater and the unsaturated zone.

RESPONSE: Bench-scale ISTD treatability tests were proposed in the February 9, 2005 Response to Comments based on a literature review of in-situ treatment technologies for MCB, DCB and PCBs. The next step in the process is to evaluate ISTD on a bench-scale to determine the effectiveness of this technology in removing MCB, DCB and PCB mass from high concentration soil samples collected from the Former PCB Manufacturing Area and the Former Chlorobenzene Process Area. A treatability test work plan for bench-scale evaluation of In-Situ Thermal Desorption will be submitted concurrently with this Response to Comments. Once these bench-scale tests are completed, the feasibility of using ISTD to achieve mass removal in source area soils will be discussed with USEPA. Issues such as the effect of the water table on ISTD will be included in these discussions.

General Comment 7: It is unclear why two different analytical methods were proposed for the analysis of MCB and DCB in the soil samples for the ISTD and enhanced aerobic bioremediation. Section 3.3 indicates that the MCB and DCB will be analyzed using SW-846 Method 8021B and Section 4.3 cites SW-846 Method 8260B. Method 8021B is the analysis for Aromatic and Halogenated Volatiles by Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors. Method 8260B is the analysis for Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC-MS). SW-846 Method 8260B is a more definitive analytical technique (both qualitatively and quantitatively) that allows tentative identification/quantitation of non-target analytes. Provide the rationale for the different analytical methods. In addition, Section 3.3 indicates that a modified SW-846 Method 8021B will be used. Provide information regarding how this method will be modified.

Consider including an SVOC analysis on the PCB soil aliquot to determine pre- and post-treatment concentrations of other SVOCs such as 3,3'-dichlorobenzidine (boiling point [b.p.] 368 °C), or its breakdown product, benzidine (b.p. 402 °C). This compound (3,3'-dichlorobenzidine) was detected in the Former PCB Storage Area (Table 5.3 of the CMS Report).

RESPONSE: All ISTD treatability test samples will be analyzed for VOCs by EPA Method 8260B and SVOCs by EPA Method 8270C.

General Comment 8: Tables in Sections 2.1 and 3.1 identify the contaminant mass and soil volumes to be treated. Site contaminants include MCB, DCBs, and PCBs, their weathered forms and degradation products, as well as other contaminants as shown in Table 5.3 of the CMS. It is our understanding that Solutia will evaluate the treatability test by comparing only the concentrations of MCB, DCBs, and PCBs detected by SW-846 8021B and/or SW-846 8260B in the soil aliquots before and after the heat treatments. This may be misleading because some of the contaminants, and their weathered forms and degradation products, are not target analytes of methods SW-846 8021B and SW-846 8260B and are not required to be reported by the laboratory.

Consider including an analysis for total organic carbon (TOC) as an empirical measure of removal efficiency. TOC is an inexpensive analysis that can estimate removal efficiency based on simple organic carbon balance. An example calculation based on the results is provided as:

$$\text{TOC (total)} = \text{TOC (naturally occurring in soil)} + \text{TOC (contaminants)}$$

$$\text{Percent Removal} = (1 - \text{TOC}_{\text{Posttreatment}} / \text{TOC}_{\text{Pretreatment}}) 100$$

A supplemental analysis for extractable organic halides (EOX) should also be considered. Like TOC, EOX analysis would provide an empirical measure of removal efficiency based on simple chloride balance. This of course assumes there are negligible amounts of organic iodine and bromine in the soil aliquots. An example calculation based on the results is provided as:

$$\text{Percent Removal} = (1 - \text{EOX}_{\text{Posttreatment}} / \text{EOX}_{\text{Pretreatment}}) 100$$

In summary, the percent treatment efficiency should not be based exclusively on the initial and final concentrations of MCB, DCBs, and PCBs because the proposed analytical methods may not detect and subsequently report other contaminants that are not listed target analytes under EPA Methods SW-846 8021B and SW-846 8260B.

RESPONSE: The goal of the bench-scale treatability tests is to determine whether or not it is feasible to remove MCB, DCB and PCB mass from source area soils in the Former Chlorobenzene Process Area and the Former PCB Manufacturing Area, respectively. MCB was targeted for mass removal treatability testing because it has migrated from the Former Chlorobenzene Process Area to the Mississippi River. DCB was included as a target compound for mass removal treatability testing because its downgradient extent of migration is within 1000 feet of the Mississippi River. PCBs were targeted for mass removal treatability testing because USEPA believes there is a potential for migration via the groundwater pathway. For these reasons, pre and post-treatment concentrations of MCB, DCB and PCB are considered the appropriate indicators of mass removal.

Analysis of treatability test soil samples for Total Organic Carbon (TOC) and Extractable Organic Halides (EOX) will not provide information about the ability of ISTD to remove MCB, DCB and PCB mass. Total Organic Carbon (TOC) will not be added to the analytical parameter list as a general indicator of mass removal because the presence of naturally-occurring organics such as humic and tannic acids reduces its effectiveness as a measure of anthropomorphic organic chemical mass removal. Extractable Organic Halides (EOX) will be added to the analytical parameter list as a general indicator for chlorinated anthropomorphic organic chemicals. USEPA Method 9023 will be used for EOX analyses.

Specific Comment 1 - Section 1.3.3, Response to Comments: This section (and Section 5.0) states that a new corrective measures array, designed to achieve the Illinois Tiered Approach to Corrective Action (TACO) cleanup criteria in fewer than 30 years, will be evaluated. Based on previous EPA comments and discussions with Solutia, the purpose of this new array is unclear. In our November 18, 2004 letter, EPA requested that Solutia, "further investigate more aggressive source treatment technologies and their potential to reduce the cleanup interval from over 100 years to dozens of years or less, before concluding that containment is the only feasible alternative." To our knowledge, there is no statutory, regulatory, or administrative requirement to complete cleanup within 30 years at the Solutia facility. Clarify the rationale for this corrective measures array and select and analyze an array that is both aggressive in terms of technology implementation but also has a reasonable probability of success using the information currently available.

Estimated costs are presented in this section for those corrective actions Solutia believes are necessary to achieve Illinois EPA's Tiered Approach to Corrective Action Objectives (TACO) criteria and Class I Groundwater Standards at source areas within the Krummrich plant process area. Some of these estimated costs appear to be inconsistent with previous CMS corrective action estimates. For example, according to the August 27, 2004, CMS Report, the proposed impermeable cap under Array 2 appears to cover roughly 72 acres at an approximate cost of \$14.9 million (M). However, this section of the RTC document suggests that only 30 acres of land could be capped for that price. This discrepancy cannot be resolved without additional cost breakdown detail. In addition, the volume and area estimates cannot be verified without a discussion of the assumptions used in their derivation. These issues should be addressed in the final CMS report.

RESPONSE: These issues will be addressed in the final CMS report.

Specific Comment 2 - Section 2.1, Mass Delineation: According to the table in this section, the volume of PCB-impacted soil above the high occupancy limit of 1 mg/kg in the Former PCB Manufacturing Area is estimated at 24,055 cubic yards (cy). The total volume of PCB-impacted soil throughout the plant process area is an estimated 250,710 cy. Provide additional information on the basis for these estimates. If the estimated volumes are based on output of the Environmental Visualization System modeling, as presented in Appendix A, specify the margin of error associated with the model. Although this information is of little concern for purposes of treatability testing, the size of potential volume errors and associated limitations on krieging should be more fully evaluated as part of remedy selection. Refer to General Comment No. 2.

RESPONSE: Volume of PCB-impacted soil in the Former PCB Manufacturing Area (24,055 cubic yards) and in the plant process area (250,710 cubic yards) was determined using existing soil concentration data and Environmental Visualization System (Version 7.92) software. The confidence of the EVS volume estimate is between 66 and 100 percent.

Specific Comment 3 - Section 2.3, Treatability Test: Section 2.3 states that the focus of the Former PCB Manufacturing Area treatability test is to determine the target treatment temperatures needed to achieve a specific PCB concentration in the unsaturated soil and to demonstrate that PCBs are either volatilized or destroyed in situ by pyrolysis and/or oxidation. If so, the PCB treatability study should include indicators such as TOC and/or EOX analyses to measure contaminant removal by mass balance.

RESPONSE: As directed by the Agency, treatability test soil samples will be analyzed for Extractable Organic Halides (USEPA Method 9023) as a general indicator of chlorinated anthropomorphic organic chemicals. Total Organic Carbon (TOC) will not be added to the analytical parameter list as a general indicator of mass removal because the presence of naturally-occurring organics such as humic and tannic acids reduces its effectiveness as a measure of anthropomorphic organic chemical mass removal.

Section 2.3 indicates that total PCBs will be analyzed using SW-846 Method 8082. It is unclear whether total PCBs will be reported based on Aroclors only, or all congeners. Reporting total PCBs based on Aroclors only may result in an inaccurate measure of total PCB removal because weathered and non-Aroclor PCBs may be reported as non-detects, or not reported at all. On the other hand, reporting total PCBs by all congeners could add significant complications to the analytical methods. Consider using EPA Method 680, which identifies and reports PCBs as isomer groups or homologs (i.e., by level of chlorination); total PCB concentration in each sample is obtained by summing each isomer groups concentration. Furthermore, amounts and relative ratios of homologs can be used to identify a source and predict fate and transport because the degree of chlorination affects solubility, degradation, and transport.

RESPONSE: USEPA Method 680 will be used to analyze treatability test soil samples for PCBs.

Only total PCBs are proposed for chemical analysis. Other hazardous constituents such as benzene, chlorobenzene, 1,2-dichlorobenzene, ethylbenzene, toluene, xylenes, 1,2,4-trichlorobenzene, 4-nitrophenol, and 3,3'-dichlorobenzidene were also detected in soil at the Former PCB Manufacturing Area (see results for soil sample location S0802 in the CMS Report). In addition to PCBs, conduct a VOC and SVOC analysis of Aliquot 4 to determine all the hazardous constituents present. All hazardous constituents present in Aliquot 4 should also be analyzed for in Aliquots 1, 2, and 3 for each soil sample depth.

RESPONSE: ISTD treatability test samples from the Former PCB Manufacturing Area will be analyzed for VOCs using USEPA Method 8260B, SVOCs using USEPA Method 8270C and EOX using USEPA Method 9023 as directed by the Agency.

A bench-scale treatability test can be conducted without prior written approval from EPA, Region 5 provided that the test complies with the self-implementing requirements for R&D for PCB disposal provided in 40 C.F.R. 761.60(c). If the amount of material containing PCBs treated annually exceeds 70 cu. ft. of non-liquid PCBs and exceeds a maximum concentration of 10,000 ppm PCBs, Region 5 written approval is required. If necessary, we will forward the procedures for written approval to Solutia.

RESPONSE: Approximately 30 kilograms of soil (less than one cubic foot) are needed for the ISTD bench-scale treatability tests. Treatability test samples will be collected at or near a sampling location with known PCB concentrations of 22,100 mg/l. However, the volume of material containing PCBs will not exceed 70 cubic feet. Consequently, written approval of the bench-scale treatability test does not appear necessary.

Specific Comment 4 - Section 3.1, Mass Delineation: According to the table in this section, the volume of MCB-impacted soil above 1 mg/kg in the Former Chlorobenzene Process Area is estimated at 56,184 cy. The total volume of MCB-impacted soil throughout the plant process area is an estimated 138,010 cy. Provide additional information on the basis for these estimates. If the estimated volumes are based on output of the Environmental Visualization System modeling, as presented in Appendix A, specify the margin of error associated with the model. Although this information is of little concern for purposes of treatability testing, the size of potential volume errors and associated limitations on krieging should be more fully evaluated as part of remedy selection. Refer to General Comment No. 2.

RESPONSE: Volume of DCB-impacted soil in the Former Chlorobenzene Process Area (1,868,990 cubic yards) and in the plant process area (12,007,400 cubic yards) was determined using existing soil concentration data and Environmental Visualization System (Version 7.92) software. The confidence of the EVS volume estimate is between 45 and 100 percent.

Specific Comment 5 - Section 3.3, Treatability Test: Treatability tests on soil samples from the vadose zone are proposed at temperatures of 150 °C, 200 °C, and 250 °C. Based on TerraTherm's experience at the Eastland Woolen site, Dr. Baker indicated that the primary and predominant mechanism for removal of chlorobenzenes from impacted soil was steam distillation, rather than direct evaporation. Therefore, the temperature range of greatest interest for treatability testing would be between the boiling point of water (100 °C) and the boiling point of chlorobenzene (132 °C) (note that the boiling points of di- and tri-chlorobenzenes are all greater than 132 °C). In addition, the case history summary of the Eastland Woolen site⁵ indicates that vaporization and removal of chlorobenzene begins to occur at the eutectic temperature of an azeotropic chlorobenzene-water mixture (90.2 °C). Therefore, treatability tests on both the vadose zone samples and on soil samples collected beneath the water table should include test aliquots at a temperature of approximately 100 °C and 132 °C.

RESPONSE: ISTD treatability tests will be conducted at 100, 132 and 200 °C.

Only MCB and DCB are proposed for chemical analysis. Other hazardous constituents such as benzene, ethylbenzene, toluene, xylenes, tetrachloroethene, MEK, MIBK, trichloroethene, cis-1,2-dichloroethene, PAHs, 1,2,4-trichlorobenzene, 2- and 4-nitrochlorobenzene, 1-chloro-2,4-dinitrobenzene, 3,4-dinitrochlorobenzene, pentachlorophenol, 2,4,5- and 2,4,6-trichlorophenol, p-chloroaniline, n-Bnitrosodiphenylamine, 2,4-dichlorophenol, 2-chlorophenol, carbazole, and dibenzofuran were detected in soil at the Former Chlorobenzene Process Area (see results for soil sample locations S1207, S1208, S1210, S1211, and S1212 in the CMS Report). Conduct a VOC and SVOC analysis of Aliquot 4 to determine all the hazardous constituents present, in addition to MCB and DCB. All hazardous constituents present in Aliquot 4 should also be analyzed for in Aliquots 1, 2, and 3 for each soil sample depth.

RESPONSE: ISTD treatability test samples from the Former Chlorobenzene Process Area will be analyzed for VOCs using USEPA Method 8260B, SVOCs using USEPA Method 8270C and EOX using USEPA Method 9023 as directed by the Agency.

Specific Comment 6 - Section 4.2.2, Technology Comparison: DNAPLs exist at the site in all three hydrogeologic units (see CMS Report, Figure 5.3.5). The SHU has significantly different hydrogeologic properties (e.g., hydraulic conductivity and transmissivity) than the middle hydrogeologic unit (MHU) and deep hydrogeologic unit (DHU) (Section 2.4 of the CMS Report). The workplan should clearly explain and evaluate the applicability of the technologies at the different hydrogeologic units separately.

RESPONSE: A soil sample from the saturated Shallow Hydrogeologic Unit will be added to the MCB/DCB DNAPL treatability test.

Specific Comment 7 - Section 4.3, Treatability Test: The text states that aquifer conditions will be simulated through the use of a large diameter column. Specify if separate tests will be conducted for the SHU and the MHU/DHU, which have very different hydrogeologic characteristics.

RESPONSE: A soil sample from the saturated Shallow Hydrogeologic Unit and a soil sample from the Middle and Deep Hydrogeologic Units will be included in the MCB/DCB DNAPL treatability test.

According to the text, the flow rates during the treatability tests will be set at a rate equivalent to the groundwater velocity in the MHU and DHU. A significant portion of DNAPL exists within the SHU, and

⁵ Baker, R.S., R.J. Bukowski, and H. McLaughlin, A Pilot-Scale Demonstration of In-Pile Thermal Destruction of Chlorobenzene-Contaminated Soil, in *Physical and Thermal Technologies: Remediation of Chlorinated and Recalcitrant Compounds*, Battelle Press, 2002, p.3.

excluding the SHU will leave a significant portion of DNAPL untreated. Include the saturated portion of the SHU (i.e., silty soils at 15 to 35' bgs at the Former Chlorobenzene Process Area) in the treatability testing.

RESPONSE: A soil sample from the saturated Shallow Hydrogeologic Unit will be added to the MCB/DCB DNAPL treatability test.

Consider designating an aliquot to be used as the control (i.e., without oxygen-saturated water flowing through it). Provide a discussion regarding how temperature and light will be controlled during the microcosm studies to closely simulate the aquifer conditions.

RESPONSE: A control microcosm will be added to the MCB/DCB DNAPL treatability test to determine the effect of DNAPL dissolution only. Influent water will be deoxygenated and a biocide will be added to the influent water to ensure that microbial degradation does not occur in the aquifer microcosm.

Distilled or deionized water, instead of actual aquifer water, is proposed to be added to the column. Examples of treatability studies included in Appendix B used actual groundwater. Even though bicarbonate will be added to adjust alkalinity, other naturally occurring groundwater elements and minerals (e.g., nitrates, sulfides, dissolved metals, chlorides, sodium) could effect the aquifer's geochemistry and bioremediation processes. Use site water if possible or in the alternative, use distilled or deionized water that is adjusted to mimic site water in elements and minerals.

RESPONSE: Four case histories for in-situ biodegradation of MCB/DCB were included in the February 9, 2005 Response to Comments. All four of these case studies used site groundwater to perform the treatability tests. Two of these case studies were bench-scale treatability tests and two were field pilot-scale tests. One bench-scale treatability test used two liters of site groundwater in each of 18 closed flasks, a total of 36 liters (9.5 gallons) of site groundwater. The other bench scale treatability test consisted of a series of column flow-through tests that used a total of 1,865 ml (0.49 gallons) of site groundwater.

Use of site groundwater to perform the proposed EABR bench-scale treatability tests would require a total of 207.2 liters (54.7 gallons) of site groundwater over a period of 13 weeks. This volume of site groundwater is more than five times greater than the volume used in the closed flask treatability tests and more than 100 times greater than the volume used in the flow-through column tests. Given the large volume of site groundwater needed for the EABR bench-scale treatability tests, it is impractical to use site groundwater to perform these tests.

Another important consideration in determining whether or not to use site groundwater to perform the EABR treatability tests is that MCB, DCB and other volatile and semivolatile organics are present in site groundwater. Since the planned bench-scale EABR treatability tests focus on how much MCB/DCB can be removed from saturated site soils, any MCB or DCB introduced into the soil microcosms makes interpretation of test results difficult because there are two sources of organics in the aquifer microcosms: 1) influent groundwater and 2) DNAPL dissolution from the aquifer matrix soil in the column. The EABR bench-scale treatability tests are designed to determine if DNAPL mass can be removed from the aquifer matrix by mass transfer and

biodegradation in pore water. Using site ground water will add MCB/DCB mass to the microcosms and decrease the amount of mass that can be removed from the aquifer matrix soil in each microcosm.

Adjusting EABR bench-scale treatability test influent to mimic site groundwater introduces a level of complexity that does not appear appropriate. MCB/DCB DNAPL mass removal from the soil in the aquifer microcosms will be governed more by mass transfer and biodegradation rates than by differences in influent water cation/anion balance.

To ensure that mass removal from the aquifer matrix in each soil microcosm is not influenced by the influent, distilled and deionized water with added nutrients will be used for the EABR treatability tests.

The treatability studies do not include discussion on potential biomass buildup. Since MCB and DCBs serve as a growth substrate, the microcosm study should consider evaluating potential biomass buildup which could limit the growth and spread of healthy microbial colonies and cause plugging of soil pores. Consider evaluating the extent of biomass buildup in one of the aliquots since this would potentially impact sustained and continuous microbial degradation.

RESPONSE: A pressure gage will be installed on each soil column to determine if backpressure is developing due to biomass build up.

The text states that changes in aqueous phase MCB/DCB concentrations will be monitored in the effluent. The test should not only monitor the dissolved phase concentrations but also measure the amount of source mass within the simulated aquifer system before and after the completion of the treatability test.

RESPONSE: Baseline saturated SHU and saturated MHU/DHU soil samples will be analyzed for VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270C) and EOX (USEPA Method 9023) as will Aliquot 1 (Sample Chemical Characterization) and Aliquot 2 (Sample Homogenization Verification). At the end of each microcosm's test duration, the microcosm will be sacrificed and the soil will be split into three aliquots (top, middle and bottom) and analyzed for VOCs, SVOCs and EOX.

MCB and DCBs are the proposed target compounds for the bench-scale treatability tests. This is appropriate, given that these were the principal constituents released at the Former Chlorobenzene Process Area and also the constituents most commonly detected in terms of both location and magnitude during the DNAPL investigation and in the downgradient groundwater plume. However, there are additional contaminants of concern (COCs) that have been consistently detected at the Former Chlorobenzene Process Area and elsewhere on site, including trichlorobenzenes, chlorophenols (di-, tri-, and penta-), methylphenols, chloroanilines, nitroanilines, and nitrobenzene. Prior to performing the bench-scale tests, it is premature to conclude that treatment of MCB and/or DCBs will be the rate-limiting processes for DNAPL removal and groundwater remediation. In addition, final cleanup standards will need to be achieved for all COCs, and thus it is important to gauge the ability of the technologies being bench-tested to treat these COCs. Modify this discussion to indicate that all identified COCs will be analyzed for in pre-test and post-test samples. Subsequently, in the bench-scale test report(s), discuss which contaminants appear to be the rate-limiting processes for the particular technologies that were evaluated.

RESPONSE: The MCB/DCB DNAPL treatability tests were designed to focus on MCB and DCB because these two constituents have the greatest extent of downgradient migration of any constituents detected at the

W.G. Krummrich facility and MCB is discharging to surface water downgradient of the W.G. Krummrich facility although such discharges cause no adverse impact. Source area mass removal focused on these two constituents with the goal of protecting the Mississippi River which is the only receptor potentially impacted by groundwater discharges from the W.G. Krummrich plant. For this reason, the goal of the treatability tests is MCB/DCB mass removal to protect the Mississippi River, not achieving soil or groundwater cleanup standards for these or other constituents.

That said, treatability test samples will be analyzed for VOCs by USEPA Method 8260B and SVOCs by USEPA Method 8270C.

The bench-scale test of enhanced aerobic bioremediation will be performed using only one oxidant (i.e., gaseous oxygen). There is a limit on the amount of gaseous oxygen that can be incorporated into an aquifer (typically around 40 mg/l at normal ambient conditions).⁶ A dissolved oxygen concentration of 40 mg/l may be insufficient to promote aerobic biodegradation of high concentrations of dissolved organic contaminants, such as would be created when DNAPL is transferred into the aqueous phase by the action of natural surfactants released by the bacteria. By using alternate oxygen-generating substances, such as hydrogen peroxide or slow-release magnesium peroxide, markedly higher oxygen concentrations (i.e., on the order of several hundred parts per million) and/or a more consistent supply of dissolved oxygen to the aquifer can be attained. In addition, storage of these oxygen-supplying substances on site requires less space and potentially reduces the flammability protection measures that would have to be installed for oxygen bottles. Lastly, while one purpose of bench-scale testing is to affirm that one preferred technology or reagent is feasible, another important benefit is the ability to evaluate different reagents to aid in selecting the optimal substance for pilot-scale testing and potential full-scale implementation. Consider including the testing of enhanced aerobic bioremediation using several different oxygen-generating substances, such as hydrogen peroxide and oxygen release compound (ORC) (a slow-release magnesium peroxide formulation marketed by Regenesis, Inc.).

RESPONSE: Using alternate oxygen-generating substances, such as hydrogen peroxide or slow-release magnesium peroxide, will not result in higher dissolved oxygen concentrations in the aquifer than can be achieved with pure oxygen. Current plans call for using a bulk liquid oxygen tank and vaporizer as the oxygen source during the pilot-scale treatability test because bulk liquid oxygen is safer to handle than hydrogen peroxide, easier to deliver in-situ than magnesium peroxide and less expensive than both of these alternative oxygen sources. Gaseous oxygen can be supplied at a rate that will keep the groundwater dissolved oxygen content in the 10 to 20 mg/l range which is more than adequate to support aerobic biodegradation of MCB and DCB that dissolve from the DNAPL on the aquifer matrix. Such a delivery system is easy to turn up if oxygen demand is higher than expected and turn down if it is lower, making it better suited for meeting oxygen demand than hydrogen peroxide or magnesium peroxide. It also has the advantage of being pure oxygen (i.e. 100 percent "reagent"), which hydrogen peroxide and magnesium peroxide are not. Pure oxygen also avoids the potential for aquifer sterilization that can result from over dosing with hydrogen peroxide.

The current test procedures for the enhanced aerobic bioremediation bench-scale studies provide no means for evaluating the survivability and adaptability of key microbial colonies essential to these reactions. Amend the test

⁶ LaGrega, M.D., P.L. Buckingham, and J.C. Evans, *Hazardous Waste Management*, McGraw-Hill, Inc., 1994, p.597.

procedures to include plate counts of the critical microbial populations (i.e., in colony-forming units) on both the untested soil samples and the microcosm samples for which the prescribed test periods tabulated on page 4-7 of the RTC document have been completed. Analyses for baseline organic carbon levels (i.e., TOC) and vital nutrients for the bioremediation processes (e.g., nitrogen and phosphorus) should also be performed in the liquid phase.

RESPONSE: As directed by the Agency, pre-treatment and post-treatment soil samples will be analyzed for plate counts (colony forming units). Distilled and deionized water with added nutrients will be used as influent for the MCB/DCB treatability tests. For that reason, it is not necessary to analyze influent or effluent for TOC, nitrogen and phosphorous.

Specific Comment 8 - Figures 4.1 and 4.2: These figures do not indicate, to the same degree of detail, the locations and depths where the treatability samples for the DNAPL bench-scale study will be collected. Provide additional figures in the workplan that show the most probable locations and depths for collection of the treatability samples. As indicated for the vadose zone MCB/DCB and PCB treatability samples (Figures 2.1 and 2.2, and 3.1 through 3.4), the samples should be collected from the zones of greatest impact, if possible. Therefore, as discussed in General Comment No. 1 above, samples from the upper portion of the SHU that previously exhibited the highest concentrations of chlorobenzenes, and thus the greatest fraction of DNAPL, should be used for this testing program.

RESPONSE: Figures showing the location of the saturated SHU and saturated MHU/DHU soil sampling locations will be included in the Enhanced Aerobic Biodegradation Work Plan.

Specific Comment 9 - Section 5, Comparative Analysis of Corrective Measure Arrays: The corrective measure arrays listed in this section consist of two components, source control and downgradient groundwater migration control. Arrays 2 and 3 have been retained from the draft CMS Report dated August 27, 2004. If Solutia intends to retain these two arrays, they should address all comments that were submitted on various elements of the proposed arrays. Please refer to General Comment Nos. 4, 5, 7, 8, and 11 in EPA's comment letter dated November 18, 2004.

Array 3 has been modified from the one presented in the draft CMS Report to include aggressive source area groundwater extraction and treatment. The specific technologies for source area treatment to be evaluated as part of Array 3 are not listed. Solutia should indicate if the technologies that are being tested in the treatability tests will be included in this array. Source area treatment options should be considered with and without groundwater extraction and treatment to evaluate the incremental gain achieved by including source area groundwater extraction and treatment in addition to ISTD or enhanced biodegradation.

As stated in EPA's General Comment No. 1 dated March 18, 2004, there is no requirement for including Array 4 for achievement of regulatory criteria in 30 years. However, Solutia may develop one array, limited to active source control measures with ISTD, along with institutional controls which includes the existing Site R slurry wall for groundwater migration control and monitoring. This array should be developed in addition to an array with more comprehensive active treatment for soil and groundwater contamination above the TACO criteria.

RESPONSE: Corrective measure arrays will be re-evaluated when the CMS is revised in response to Agency comments.

Specific Comment 10 - Section 6.1: Table 6.1 provides the proposed screen elevations for monitoring wells MW #1 to #17. Proposed screen elevations for these monitoring wells are:

MW #4, 5, 6, 7, 10, 11, 12, 14, 15, and 16	270' to 275'
MW #17	285' to 290'
MW #9 and 13	290' to 295'
MW #8	305' to 310'
MW #1 and 3	330' to 335'
MW #2	345' to 350'

Comparing these elevations to the bedrock surface map (see Figure 4.3 of the CMS Report), most of the plume stability monitoring wells would be screened in bedrock which is present at 297' to 310' beneath the facility, and at 280' to 285' at the river. All wells should be screened above bedrock which is generally found at approximately 300' beneath the facility. Screen elevations in Table 6.1 need to be corrected and justification provided for the chosen screen elevations.

RESPONSE: Projected screen elevations presented in Table 6.1 were based on a model which did not include the bedrock surface as the lower boundary. The model will be revised to include bedrock elevations from confirmed locations (i.e., borings). Monitoring wells will be screened above bedrock in the area of highest projected impact.

Monitoring wells are typically screened across the same hydrogeologic unit, e.g., the SHU at 380' to 395', MHU at 350' to 380', DHU at 300' to 350', or TOR at 280' to 310'. However, the proposed plan has wells screened at various elevations that are expected to straddle the highest MCB or DCB concentrations modeled using EVS software and the existing data set. Solutia needs to justify the chosen screen elevations and ensure that they are properly located in the most contaminated strata within the SHU, MHU, or DHU.

RESPONSE: - Monitoring well screens will be located in the zone of highest groundwater concentration beneath and downgradient of the W. G. Krummrich Facility. Screen depth selection will be explained in the Plume Stability Monitoring Plan, which will be submitted on July 5, 2005.

As noted in EPA's letter dated November 18, 2004, General Comment No. 2, there were several inconsistencies regarding the nature and extent of groundwater contamination in the draft CMS Report. Solutia should prepare and submit in the workplan, a clear description of the nature and extent of VOC and SVOC contamination in each hydrogeologic unit in order to support the proposed monitoring well locations and screen depths listed in Table 6.1. Also, MCB and DCB are not the only contaminants at all sample locations, as shown in Table 5.8 of the draft CMS Report. Solutia should consider all COCs above the screening value in the selection of monitoring wells and screen intervals.

RESPONSE: Plume maps will be prepared for key site-related constituents in each hydrogeologic unit and used to help select monitoring well screen depths.

In Figure 6.1, the location of Well #1 would appear to be affected by facility activities and not be reflective of background conditions. Consider locating the background well off-site. Also, Well #6 appears to be located in Site P. This well should be located out of the fill area and upgradient of Site P.

RESPONSE: The intent of location MW-1 is to be upgradient of the W.G. Krummrich plant process area. MW-1 will be relocated to the north, just north of the intersection of Monsanto Avenue and Falling Springs Road. This location is still on WGK property and, based on a CA-750 groundwater profile location (TRA 1 GP-B), does not exhibit the primary site-related constituents such as MCB and DCB. MW-6 will be moved so that

it is located between Site P and the warehouse to the east of Site P.

To ensure adequate coverage and proper monitoring of contaminant concentrations discharging to the Mississippi River that are not captured by the groundwater migration control system, include an additional monitoring well between well #15 and #16. Well #15 should be offset to the north to attain somewhat equal spacing of the wells at the rivers edge, if feasible.

RESPONSE: The area between proposed Monitoring Wells 15 and 16 is a heavily-used bulk storage area (Cahokia Marine Services). It will be difficult to get permission to install a monitoring well in this area and difficult to ensure that the well is not damaged by normal business activities in this area. Proposed Monitoring Well 16 could be moved approximately 400 to 600 feet north to an area on Cahokia Marine Services property where installation of a well may not interfere with site operations. Proposed Monitoring Well 15 could be moved a similar distance to the north. Both location changes would provide better coverage of that portion of the W.G. Krummrich plume not captured by the Sauget Area 2 Groundwater Migration Control System.

Specific Comment 11 - Section 6.2: Clarify the sampling frequency discussed in this section. The wording appears to be inconsistent. EPA understands the proposed sampling program to be quarterly for the first two years, semiannually for the next three years, and annually thereafter. Sampling should not be conducted any less frequent than semiannually. Quarterly sampling may need to be performed longer than two years to develop appropriate statistics (e.g., decreasing, increasing, or stable trends).

RESPONSE: Quarterly monitoring will be performed during the first two years to develop a baseline for assessing plume stability. We acknowledge that, if necessary, this period may need to be extended to develop the appropriate statistics. Monitoring will be conducted on a semiannual basis after completion of the baseline period.

In Table 6.3, update and provide data for piezometers GWE-11, -12, -13, -16, -17, -18, -19, -20, and -21.

RESPONSE: GWE-11, 12, 13, 16, 17, 18, 19, 20 and 21 were installed to measure groundwater levels during implementation of the Sauget Area 1 EE/CA and RI/FS Support Sampling Plan. Three one-inch diameter piezometers were installed at each groundwater level measurement location with one piezometer screened at the top of the SHU (20 ft bgs), a second screened at the top of the MHU (40 ft bgs) and a third screened at the top of the DHU (60 ft bgs). Ten foot long screens were installed in each piezometer. Top of casing elevations are given below:

<u>Piezometer Cluster</u>	<u>Shallow</u>	<u>Middle</u>	<u>Deep</u>
GWE-11	416.69	416.70	416.65
GWE-12	414.83	414.97	414.90
GWE-13	415.92	415.94	415.97
GWE-16	410.87	410.57	410.90
GWE-17	407.52	407.44	407.60
GWE-18	409.26	409.10	409.48
GWE-19	411.81	411.68	411.85

GWE-20	410.11	409.81	410.15
GWE-21	412.01	412.08	412.16

Well construction records are not available for these piezometers. As part of the first groundwater sampling round, these piezometers will be probed to determine their depths and this information will be incorporated into a groundwater level piezometer and well construction summary table.

In addition to the proposed groundwater elevation information to be obtained at the 23 existing piezometer clusters, obtain groundwater elevations at the 18 proposed monitoring well at the same time. Monitoring wells located near source areas should also be checked for NAPL prior to sampling.

RESPONSE: Groundwater levels will also be measured in the new groundwater monitoring wells and these data will be incorporated in the groundwater elevation contour map prepared after each sampling round.

Source area monitoring wells MW-2, 3, 4 and 5 will be checked for LNAPL and DNAPL at the start of each sampling round.

Based on the CMS data for DHU wells, other hazardous constituents such as benzene, ethylbenzene, toluene, xylenes, 2-chlorophenol, 2,4-dichlorophenol, phenol, p-chloroaniline, and naphthalene are also present in deep groundwater. It would be preferable to analyze groundwater for all RCRA hazardous constituents (e.g., RCRA Appendix IX Ground-Water Monitoring List) to see what is present and then propose an analyte list based on that data.

RESPONSE: Groundwater samples obtained during the first sampling round will be analyzed for RCRA hazardous constituents, specifically 40 CFR Appendix IX VOCs (Method 8260B), SVOCs (Method 8270C), PCBs (Method 680), Pesticides (Method 8081A), Herbicides (Method 8151A), and Metals (Method 6010). A focused analyte list will then be proposed for subsequent events.

The proposed laboratory analyses for monitored natural attenuation (MNA) does not include analyses for the degradation products of MCB and DCB, nor does it propose to conduct bacterial plate counts. In addition, the analytical methods are not specified. Knowing the concentration trends of the contaminants and degradation products will allow Solutia to verify whether decreasing MCB and DCB concentrations are due primarily to biodegradation, or other physical attenuation processes. Specifying the analytical methods ensures data comparability and consistent quality control requirements throughout the monitoring program. Solutia should use mass spectrometric methods that could provide identities of non-target compounds (SW846 Method 8260) and identify weathered PCBs (EPA Method 680). Bacterial plate counts can be added at the start or towards the end of the monitoring program to predict sustainable degradation process or explain steady state plume conditions.

RESPONSE: After the first sampling round, groundwater samples will be analyzed for VOCs (Method 8260B), SVOCs (Method 8270C), PCBs (Method 680), Pesticides (Method 8081A), Herbicides (Method 8151A) or Metals (Method 6010) depending upon the constituents detected in the first sampling round. Past groundwater sampling indicates that the primary constituents migrating from source areas to or toward the Mississippi River are MCB (Method 8260B) and DCB (Method 8270C).

As long as MCB and DCB concentrations continue to decrease it is not necessary to know the specific natural

attenuation process, either biotic or abiotic, that resulted in the observed reductions. However, if it is possible to detect and quantify the MCB and DCB aerobic biodegradation products listed below using USEPA Methods 8260B and 8270C, they will be reported as part of the groundwater monitoring program:

Aerobic Degradation Pathways for Monochlorobenzene and Dichlorobenzene



Bacterial plate counts will be performed annually to determine the number of colony forming units present in groundwater at each sampling location.

The monitoring program does not include a discussion of field and groundwater parameters (i.e., pH, oxidation/reduction potential [ORP], specific conductance, or dissolved oxygen [DO]) to be measured during the groundwater sampling events. These geochemical data can be used to identify the type and sustainability of natural attenuation processes along the plume path. Solutia should consider including or clearly indicating that these field and groundwater parameters will be measured during sampling.

RESPONSE: Specific conductance, pH, ORP and DO are standard field measurements that will be included in the groundwater monitoring work plan.

Specific Comment 12 - Section 6.3: It is unclear whether a statistical trend analysis will be performed on the plume boundary and transect wells. The workplan should clearly indicate whether concentration versus time plots will be prepared, and if trends will be evaluated visually or statistically.

RESPONSE: A method for determining plume stability will be proposed to the Agency after completing two years of baseline groundwater quality data collection. Data from the baseline data collection period will be used to establish baseline statistical information such as normality, distribution, standard deviation, etc. Once the data distribution is known to be either normal, log normal or non-parametric, an appropriate statistical test will be proposed to determine the stability of the plume.

Concentration versus time plots will be created for each monitoring well in order to depict temporal changes in the concentration of the highest detected constituent concentration for each parameter group (VOCs, SVOCs, PCBs, Pesticides, Herbicides or Metals) included in the groundwater monitoring program.

Specific Comment 13 - Section 7.1: Based on the proposed schedule for source control evaluation, the ISTD treatability tests should be completed this summer. As we discussed, the ISTD treatability tests and subsequent pilot field tests should be fast-tracked. Therefore, consider separate schedules for the ISTD treatability tests and

the in-situ bioremediation treatability tests, and consider stand-alone work plans and treatability test reports for each technology. The treatability test reports should discuss and propose a schedule for pilot-scale testing. A meeting can be held within two weeks of EPA's receipt of each treatability test report to discuss the path forward for pilot-scale testing.

RESPONSE: Stand-alone work plans will be submitted for the In-Situ Thermal Desorption and Enhanced Aerobic Biodegradation treatability tests. These tests will be conducted on separate schedules with the ISTD tests completed before the EABR tests because of the 3 month duration of the latter. Once sample analysis and data validation are completed, treatability test reports will be prepared for ISTD and EABR. The ISTD Treatability Test Report will evaluate whether or not PCB mass removal is feasible in the unsaturated SHU and MCD/DCB mass removal is feasible in the unsaturated and/or the saturated SHU. The EABR Treatability Test Report will assess if the EABR bench-scale treatability test indicates that MCB/DCB mass removal is feasible in the saturated SHU and/or saturated MHU/DHU.

The extent of PCB contamination at the Former PCB Manufacturing Area has not yet been fully delineated. The time frame for determining the full extent of PCB contamination should be considered in the required schedules.

RESPONSE: Enough information is available on the extent of PCB in soils at the Former PCB Manufacturing Area to allow implementation of ISTD in known impacted areas if the pilot-scale treatability tests indicate this technology can achieve cost-effective mass removal.

The schedule does not discuss when the comparative analysis of corrective measure arrays (referenced in Section 5.0) will be completed and submitted to EPA.

RESPONSE: Corrective measure arrays will be re-evaluated when the CMS is revised in response to Agency comments.

Currently, EPA and Solutia have discussed the use of interim measures to address source control. A focused interim corrective measures evaluation, with proposed full-scale implementation of applicable technologies, will be required upon completion of the treatability tests and pilot-scale tests. Appropriate technologies for addressing the identified source areas, such as ISTD, in-situ bioremediation, excavation/off-site disposal, and on-site containment should be evaluated. The time frame for completing the comparative analysis of final corrective measure arrays will be determined in the future based on the progress of the source control work and interim corrective measures to be performed.

RESPONSE: Comment noted.

Specific Comment 14 - Section 7.2: Submit a stand-alone workplan for the groundwater monitoring program that adequately addresses comments on Section 6 in this Enclosure and comments previously provided to Solutia in a letter dated December 3, 2004. Include an updated schedule for groundwater monitoring in the workplan.

RESPONSE: A stand-alone work plan for the groundwater monitoring program will be submitted on July 5, 2005.

Specific Comment 15 - Appendix C: Appendix C contains the calculations for the remediation time frame (RTF). It is not clear how the three degradation equations presented will be used to calculate the RTF in conjunction

with the degradation rate to be calculated from the results of the microcosm studies. Please explain why step function and linear decay equations were presented.

RESPONSE: First order decay equations will be used to estimate remediation time frame instead of step function or linear decay equations.

Supplemental information requested by EPA in its November 18, 2004, letter is not fully addressed in Solutia's Response to Comments submitted on February 9, 2005. The supplemental investigations identified below are necessary to further characterize potential source areas and associated risks. The investigations must be performed this summer concurrently with the proposed treatability testing. All work must be performed in a manner consistent with previous work and the EPA Region 5 RCRA QAPP Policy. Provide the information requested, all validated results, logs of all borings, and figures delineating all sample locations as an Addendum to the CMS Report. The Addendum must be submitted to EPA by September 1, 2005.

Route 3 Drum Site

Additional detail is needed to document the interim action to determine what, if, any additional remedies are necessary. Characterization of groundwater in the vicinity of the Route 3 Drum Site is also needed to determine if the interim action is sufficient to protect human health and the environment.

Decomposing drums and associated wastes were excavated from the southwestern corner of Lot F in 1986 and 1987. Confirmation sampling completed after the excavation indicated that approximately 7,000 cubic yards of contaminated soil remained in the trench. In October 1987, a composite-compacted clay and high density polyethylene liner cap was installed over the trench. Provide the following additional detail:

- The results for any residual concentrations of all compounds of nitrochlorobenzene, dichloronitrobenzene, dinitrochlorobenzene, nitrobiphenyl, and any other contaminants exceeding applicable standards when capping was completed in this area.
- Section 7 of CMS Addendum II documents that 3500 drums of B-221 Ortho, 250 drums of Eutectic, and 585 drums of dinitrochlorobenzene were disposed at the drum site. Provide information on the hazardous constituents likely to be present in "B-221 Ortho" and "Eutectic".
- Any noticeable impacts on contaminant trends in groundwater for the constituents remaining in this area above applicable standards after capping.
- General procedures for and frequency of inspections and maintenance to ensure that cap integrity is not compromised.
- Verification that this capped area is encircled by the chain link fence mentioned in Section 5.2.1.2 of the CMS Report, and that the chain link fence encompasses the originally estimated soil impact area (meaning that the Phase II geophysical investigation and trenching was conducted outside the known Route 3 Drum Site impact area).
- An indication as to how such inspection and maintenance efforts are funded. These activities and costs should be considered in the final corrective measures array analysis.

Monitoring wells GM-8, GM-31A, GM-31B, GM-31C, GM-54A, GM-54B, GM-58A, and GM-59A are located in the immediate vicinity of the Route 3 Drum Site. Historical data presented in Appendix F, Volume II of II, *Summary of Ground-Water Quality Conditions*, December 9, 1997, and graphs of water quality data presented in Figures E-6 and E-7 of the same report show significant concentrations of dinitrophenol, phenol, nitrobenzene, dinitrochlorobenzenes, nitrochlorobenzenes, and nitrobiphenyl in groundwater at GM-31A and to a lesser extent, at GM-58A. Both wells appear to monitor the water table at the Route 3 Drum Site. Redevelop the eight monitoring wells listed above, obtain groundwater samples, and analyze, at minimum for SVOCs and PCBs (PCBs were identified in soils during the partial cleanup of the Route 3 Drum Site). Include other constituent groups if warranted based on hazardous constituents expected to be present in "B-221 Ortho" and "Eutectic".

Provide a figure delineating the boundaries of the Route 3 Drum Site and location of each monitoring well

sampled. Include individual constituent concentrations found in groundwater at each monitoring well sampled. Also confirm that the trench was excavated to 390' AMSL and provide the screened intervals for each monitoring well sampled.

Lot F

PCBs in surface soil (0-2') were detected in Lot F at sample locations S0205, S0206, and S0208. The PCB concentration in exposed surface soil at sample location S0205 (2.5 mg/kg) exceeds the TACO Tier 1 criteria for direct contact with soils of 1 mg/kg. PCBs were also detected nearby in soil during the 1986 cleanup at the Route 3 Drum Site. Further investigation is necessary in this area of Lot F to determine the areal extent of PCB contamination and associated human health and ecological risk in this area. Sample surface soil (0-2') and analyze for PCBs at the mid-point between soil sample locations S0205 and S0206, the midpoint between soil sample locations S0205 and S0208, and 100' both north and south of soil sample location S0205 (total of 4 samples).

At sample location S0110 in Lot F, 13.2 mg/kg of total PAHs were detected in exposed surface soil (0-2'). The boring log shows that a sand silty fill with brick and cinders was present at 1' to 2.5' beneath the surface one-foot of topsoil. The TACO Tier 1 criteria for direct contact with soils is exceeded for benzo(a) pyrene in this sample. Lead is also present in exposed surface soil (at 300 mg/kg) approaching the TACO Tier 1 criteria for direct contact with soils. Other sample locations in the area are 300' to 400' away. Further investigation is necessary to define the extent of this fill area and associated human health and ecological risk. Based on the July 4, 1940 aerial photo, sample location S0110 appears to be located in the middle of a large area of disturbed ground. Sample surface soil and analyze for SVOCs and total lead approximately 100' north, south, east, and west of soil sample location S0110, and also 200' north and south of soil sample location S0110 (total of 6 samples). These suggested sampling locations are approximate and should be properly located to encounter fill likely present in this area.

The LF-series soil sample locations at the southwest corner of Lot F were sampled at 18 to 20-feet. VOCs (benzene, chlorobenzene, tetrachloroethene, dichloromethane, ethylbenzene, and xylene) were detected at LF-2, LF-3, and LF-4. SVOCs (1,2-dichlorobenzene, 2-methylnaphthalene, carbazole, nBnitrosodiphenylamine, and phenol) were also detected at LF-4. Table 5.4 shows that benzene, carbazole, nBnitrosodiphenylamine, and dichloromethane had concentrations at LF-4 that exceeded the TACO Tier 1 soil to groundwater leaching criteria. Aerial photos indicate past activity (e.g., surface impoundment, disturbed ground) in this area. Further investigation of this area is necessary to accurately determine the areal and vertical extent of the VOCs and SVOCs that exceed the TACO Tier 1 criteria for soil to groundwater leaching criteria. Describe whether the 18-20' sample depths were from the unsaturated zone. Sample deep soil (18-20') and analyze for VOCs and SVOCs 100' north, south, east, and west of soil sample location LF-4 (total of 4 samples).

Former Chlor-Alkali Production Area

Based on data from S-09-16, S-09-17, S-09-19, and S-09-20, there is an area identified at the Former Chlor-Alkali Production Area that exceeds TACO Tier 1 criteria for direct contact with soils for mercury. The areal extent of this contamination needs to be further defined east of S-09-16 between S-09-22 and S-09-23; west and south of S-09-17 between S-09-11 and S-09-12, and S-09-10 and S-09-11; and northwest of S-09-19 between S-09-13 and S-09-14. Furthermore, the deepest sample (7 to 10-feet) obtained at S-09-19, S-09-16, and S-09-20 exceeds the TACO Tier 1 criteria for direct contact with soils for mercury. Mercury contamination is present in the fill, clayey silt, and silty clay but is not defined in the deeper sand which was not encountered in the borings. Further investigation of this area is necessary to define the areal and vertical extent of mercury contamination exceeding either the TACO Tier 1 criteria for direct contact with soils or the soil to groundwater leaching criteria. Sample soil at depths of 2-3', 6-7', and 9-10' and analyze for mercury at the mid-point between soil sample locations S0910 and S0911, the midpoint between soil sample locations S0911 and S0912, the mid-point between soil sample locations S0913 and S0914, and the midpoint between soil sample locations S0922 and S0923 (total of 12 samples), and also at 13-15' at soil sample locations S0916, S0919, and S0920 (total of 3 samples).

PCBs in the Former Chlor-Alkali Production Area were detected at 13 and 5 ppm at soil sample locations S0904 and S0905, respectively. The PCBs are present in the fill which is 9 to 13-feet deep. Conduct additional sampling of the fill in this area to confirm whether PCB concentrations are consistently less than the 25 ppm screening criteria. Sample the fill (shallow or intermediate sample) and analyze for PCBs at S0902 (4-6'), S0903 (2-4'), S0906 (6-8'), S0907 (10-12'), S1003 (4-6'), S1004 (3-5'), and the mid-point between soil sample locations S0904 and S0905, the midpoint between soil sample locations S0904 and S0906, and the mid-point between S0905 and S0907 (total of 9 samples).

Soil Sample Location S0403

A strong odor and elevated PID reading were noted in the boring log for sample location S0403 but no VOCs or SVOCs were detected in the only soil sample taken (2-4'). No intermediate or deep sample was taken in sand where a strong odor, hydrocarbon odor, and elevated PID readings were noted. Resample this location at the 1-3' and 10-12' interval and analyze fill/soil for VOCs, SVOCs, pesticides/herbicides, and PCBs (total of 2 samples)

Soil Sample Locations S0408 and S0409

Sample locations S0408 and S0409 identified an area (bounded by S0-4-23 to the east) where soils at an intermediate depth have elevated chlorobenzene, 1,3-dichloropropene, toluene, ethylbenzene, and xylene (VOC) concentrations. Aerial photographs indicate that this area was a tank farm from at least 1940 through the 1980's. Further investigation of this area is necessary to define the areal and vertical extent of VOCs that exceed either the TACO Tier 1 criteria for direct contact with soils or the soil to groundwater leaching criteria. Sample fill/soil 100' north, northeast, southwest, and west of soil sample location S0408 and analyze for VOCs (total of 4 samples). Probe and log to 15', and sample at the intermediate depth with the highest PID reading or most obviously contaminated.

Soil Sample Locations S1101, S1102, and S1103

Soil sample locations S1101, S1102, and S1103 were used to investigate the eastern open area of the Solutia facility. The boring logs in CMS Addendum I show that fill is present at all three sample locations, varying from two to nine feet. However, no surficial samples were obtained to determine the potential risks associated with surface fill. Resample locations S1101, S1102, and S1103 and obtain shallow (0-2') samples and analyze for SVOCs (total of three samples).

RESPONSE: A supplemental soil and groundwater sampling work plan will be prepared and submitted to USEPA on July 5, 2005 that includes sampling at the following locations as directed by the Agency:

Route 3 Drum Site

- Redevelop and sample Monitoring Wells GM-8, GM-31A, GM-31B, GM-31C, GM-54A, GM-54B, GM-58A, and GM-59A.
- Analyze groundwater samples for SVOCs (USEPA Method 8270C) and PCBs (USEPA Method 680).

Analysis for other constituent groups is not warranted because "B-221 Ortho" and "Eutectic", respectively, refer to where nitrochlorobenzene was manufactured at the W.G. Krummrich plant (Building 221) and manufacturing byproducts ("ortho"-nitrochlorobenzene and "eutectic" oil). Consequently, SVOC analysis will adequately characterize these materials.
- A total of eight groundwater samples will be collected and analyzed to determine if the interim action

(excavation and off-site disposal, capping and fencing), in addition to groundwater collection at the Sauget Area 2 Groundwater Migration Control System, is sufficient to protect human health and the environment.

Lot F

Sample Locations SO205, SO206 and SO208

- Collect a soil sample from a depth of 0 to 2 ft bgs located at the midpoint between soil sample locations SO205 and SO206 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from a depth of 0 to 2 ft bgs located at the midpoint between soil sample locations SO205 and SO208 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from a depth of 0 to 2 ft bgs located 100 ft. north and 100 ft. south of soil sample location SO205 and analyze for PCBs (USEPA Method 680).
- A total of four surficial soil samples will be collected and analyzed for PCBs to determine the areal extent of PCB-containing soils and the associated human health and ecologic risk in this area.

Sample Location SO110

- Collect a soil sample from a depth of 0 to 2 ft bgs located 100 ft. north, south, east and west of soil sample location SO110 and analyze for SVOCs (USEPA Method 8270C).
- Collect a soil sample from a depth of 0 to 2 ft bgs located 200 ft. north and south of soil sample location SO110 and analyze for SVOCs (USEPA Method 8270C) and Lead (USEPA Method 6010B).
- A total of six surficial soil samples will be collected and analyzed for SVOCs and Lead to define the extent of this fill area and associated human health and ecological risk.

Sample Location LF-4

- Collect a soil sample from a depth of 18 to 20 ft bgs located 100 ft. north, south, east and west of soil sample location SO110 and analyze for VOCs (USEPA Method 8260B) and SVOCs (USEPA Method 8270C).
- A total of four subsurface soil samples will be collected and analyzed for VOCs and SVOCs to determine the areal and vertical extent of VOC and SVOC-containing soils that exceed the TACO Tier I criteria for soil to groundwater leaching.

Former Chlor-Alkali Production Area

Mercury

- Collect soil samples from depths of 2 to 3 ft, 6 to 7 ft and 9 to 10 ft bgs at the midpoint between soil sample locations SO910 and SO911 and analyze for Mercury (USEPA Method 7470C).
- Collect soil samples from depths of 2 to 3 ft, 6 to 7 ft and 9 to 10 ft bgs at the midpoint between soil sample locations SO911 and SO912 and analyze for Mercury (USEPA Method 7470C).
- Collect soil samples from depths of 2 to 3 ft, 6 to 7 ft and 9 to 10 ft bgs at the midpoint between soil sample locations SO913 and SO914 and analyze for Mercury (USEPA Method 7470C).

- Collect soil samples from depths of 2 to 3 ft, 6 to 7 ft and 9 to 10 ft bgs at the midpoint between soil sample locations S0922 and S0923 and analyze for Mercury (USEPA Method 7470C).
- Collect a soil sample from a depth of 13 to 15 ft bgs at soil sample location S0916 and analyze for Mercury (USEPA Method 7470C).
- Collect a soil sample from a depth of 13 to 15 ft bgs soil sample location S0919 and analyze for Mercury (USEPA Method 7470C).
- Collect a soil sample from a depth of 13 to 15 ft bgs at soil sample location S0920 and analyze for Mercury (USEPA Method 7470C).
- A total of 15 subsurface soil samples will be collected and analyzed for Mercury to define the areal and vertical extent of soils containing mercury at concentrations higher than the TACO Tier I criteria for direct contact with soils or the soil to groundwater leaching criteria.

PCBs

- Collect a soil sample from 4 to 6 ft bgs at soil sample location S0902 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from 2 to 4 ft bgs at soil sample location S0903 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from 6 to 8 ft bgs at soil sample location S0902 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from 10 to 12 ft bgs at soil sample location S0907 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from 4 to 6 ft bgs at soil sample location S1003 and analyze for PCBs (USEPA Method 680).
- Collect a soil sample from 3 to 5 ft bgs at soil sample location S1004 and analyze for PCBs (USEPA Method 680).
- Collect a fill sample at the midpoint between soil sample locations S0904 and S0905 and analyze for PCBs (USEPA Method 680).
- Collect a fill sample at the midpoint between soil sample locations S0904 and S0906 and analyze for PCBs (USEPA Method 680).
- Collect a fill sample at the midpoint between soil sample locations S0905 and S0907 and analyze for PCBs (USEPA Method 680).
- A total of nine subsurface soil samples will be collected and analyzed for PCBs to confirm whether PCB concentrations are consistently less than the 25 ppm screening criteria.

North Central Plant Process Area

Soil Sample Location S0403

- Collect a fill/soil sample from 1 to 3 ft bgs at soil sample location S0403 and analyze for VOCs

(USEPA Method 8260B), SVOCs (USEPA Method 8270C), Pesticides (USEPA Method 8081A), Herbicides (USEPA Method 8151A) and PCBs (USEPA Method 680).

- Collect a fill/soil sample from 10 to 12 ft bgs at soil sample location S0403 and analyze for VOCs (USEPA Method 8260B), SVOCs (USEPA Method 8270C), Pesticides (USEPA Method 8081A), Herbicides (USEPA Method 8151A) and PCBs (USEPA Method 680).
- A total of two soil samples will be collected at sampling depths where strong odors and elevated PID readings were noted in the boring log for sample location S0403.

Soil Sample Locations S0408 and S0409

- Collect a fill/soil sample from the intermediate depth with the highest PID reading or most obviously impacted depth between ground surface and 15 ft bgs at locations 100 ft. north, northeast, southwest and west of soil sample location S0408 and analyze for VOCs (USEPA Method 8260B).
- A total of four soil samples will be collected to define the areal and vertical extent of VOCs that exceed either the TACO Tier I criteria for direct contact with soils or the soil to groundwater leaching criteria.

Former Coal Storage Area

- Collect a surface soil sample from 0 to 2 ft bgs at soil sample location S1101 and analyze for SVOCs (USEPA Method 8270C).
- Collect a surface soil sample from 0 to 2 ft bgs at soil sample location S1102 and analyze for SVOCs (USEPA Method 8270 C).
- Collect a surface soil sample from 0 to 2 ft bgs at soil sample location S1103 and analyze for SVOCs (USEPA Method 8270 C).
- A total of three soil samples will be collected to determine the potential risks associated with surface fill.

In recent meetings, EPA presented to Solutia, a hydrographic survey map generated by the U.S. Army Corps of Engineers (ACE) that depicts the depth to sediment in the Mississippi River in the vicinity of the Solutia facility. Two depositional areas located along the eastern-half of the river at Arsenal Island and Jefferson Barracks, approximately 4 and 8 miles downstream of the interim groundwater remedy, appear to be representative of hydraulic environments where contaminants from historical releases to the river may have migrated and accumulated in deep sediment.

Three grab samples of surficial sediment taken at Arsenal Island area during the October 2000, sampling event contained detectable concentrations of chlorobenzene, pentachlorophenol, toluene, and/or PAHs. Surface water at two locations at Arsenal Island detected benzene, chlorobenzene, 2-chlorophenol, 2,4-dichlorophenol, 4-chloroaniline, toluene, 2,4-D, and/or 2,4,5-T. EPA is not aware of any sampling performed further downstream at Jefferson Barracks, an area where ACE installed a dike field to promote sediment deposition.

EPA believes that sediment characterization is needed at Arsenal Island and Jefferson Barracks to determine whether site-related contaminants are present, including their vertical and horizontal extent, and whether they pose a potential risk in their current location or release during flood events. Solutia's position is that Mississippi River sediments have been adequately characterized by sampling events previously performed under RCRA and CERCLA authority. At this time, EPA continues to believe that supplemental investigations are warranted at Arsenal Island and Jefferson Barracks and is evaluating its options for addressing this potential data gap in the site investigations.

Section VI.5.b of the Administrative Order on Consent provides for EPA to request reasonable supplemental information from Solutia if its Final Corrective Measures Proposal and supporting information do not provide an adequate basis for selection of final corrective measures that must protect human health and the environment from the releases of hazardous waste or hazardous constituents at or from the facility. EPA reserves its right to request reasonable supplemental information in the form of chemical characterization and risk assessment of depositional areas of sediment in the Mississippi River downstream of the Solutia facility.

RESPONSE: Solutia notes USEPA's comment and reserves its right to dispute the need for any additional sediment characterization in the Mississippi River. Sediment sampling previously conducted in the Mississippi River within, upstream and downstream of the W.G. Krummrich plume discharge area demonstrated that impacted sediments were confined to a 2000 ft. long by 300 ft. wide area of the river channel immediately adjacent to Sauget Area 2 Site R. No adverse impacts were observed or predicted upstream or downstream of this area. For that reason, additional sediment sampling is not necessary or appropriate.

A 3,300 ft. long, 140 ft. deep, "U"-shaped barrier wall was installed downgradient of Site R between August 2002 and November 2004. Equipped with three groundwater extraction wells on the upgradient side of the barrier wall, this system is designed to capture impacted groundwater entering the "U"-shaped barrier wall to mitigate the impact of groundwater discharge on surface water downgradient of Site R. Extracted groundwater is discharged to the American Bottoms Regional Treatment Facility for treatment before discharge to the Mississippi River at the upstream end of Site R. This groundwater migration control system was designed and built to mitigate adverse impacts due to the discharge of groundwater to surface water downgradient of Site R.

Sediment and surface water monitoring in the Mississippi River adjacent to Site R are scheduled to start in June 2005 to determine if impacted groundwater is migrating through, beneath or around the barrier wall and

causing an adverse impact when it discharges to the river.

In addition, Solutia has worked with the Sauget Area 2 Sites Group (SA2SG) and USEPA Region 5 to carry out an extensive RI/FS of the Sauget Area 2 Sites. The SA2SG completed further sediment sampling downstream of Site R and Site Q during 2003, with additional sampling planned in 2005. The results of this sediment sampling will be incorporated into the Sauget Area 2 RI/FS and considered, along with the extensive soil, waste and groundwater sampling results obtained during implement of the Sauget Area 2 RI/FS Support Sampling Plan, in determining what remedial actions might be necessary for Sauget Area 2.

SOLUTIA - 198

June 23, 2005

DE-9J

VIA E-MAIL AND CERTIFIED MAIL
RETURN RECEIPT REQUESTED

7001 0320 0006 1565 3539

Mr. Steven D. Smith
Solutia Inc.
P.O. Box 66760
St. Louis, MO 63166-6760

RE: Response to Comments and Treatability Study Work Plans
Administrative Order on Consent
U.S. EPA Docket No. R8H-5-00-003

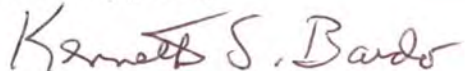
Dear Mr. Smith:

We have completed a review of Solutia's Response to Comments, *In-Situ Thermal Desorption Work Plan*, and *Enhanced Aerobic Bioremediation Work Plan* submitted on May 27, 2005. The Response to Comments and Work Plans were submitted to address EPA's May 4, 2005, comments on the Corrective Measures Study.

Clarifications to the Response to Comments and Work Plans are provided in the Enclosure to this letter. Solutia should immediately proceed with the proposed work and schedules, incorporating the enclosed comments.

If you have any questions, please contact me at (312) 886-7566 or at bardo.kenneth@epa.gov.

Sincerely yours,



Kenneth S. Bardo, Project Manager
Corrective Action Section

cc: Jim Moore, IEPA
Gina Search, IEPA
Bruce Yare, Solutia (e-mail)

bcc: Richard
Nat

DE-9J

U.S. EPA
77 W. Jackson Blvd
Chicago, IL 60604
Attn: Ken Bardo

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Steve Smith
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St. Louis, MO 63166-6260

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- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Steve Smith
Solvia Inc.
575 Maryville
St. Louis, MO 63141 260

2. Article Number
(Transfer from service label)
PS Form 3811, March 2001

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C. Signature
X *Young*

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B. Date of Delivery
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Agent
☒ Addressee
☐ Yes
☐ No

3. Service Type
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☐ C.O.D.
☐ (Extra Fee)

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☐ Yes
☐ No

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102595-01-M-1424

Enclosure

Supplemental Information

As stated in our May 4, 2005, letter, the request for supplemental information does not require the preparation of a work plan for implementation. Work to obtain the supplemental information should begin immediately and must be performed in a manner consistent with previous facility investigation work and the EPA Region 5 RCRA QAPP Policy. The information requested, all validated results, logs of all borings, and figures delineating all sample locations should be submitted as an Addendum to the August 27, 2004, CMS Report. The Addendum must be submitted to EPA by September 1, 2005.

Solutia proposes to prepare and submit a supplemental soil and groundwater sampling work plan on July 5, 2005. Solutia may use the work plan to assist field personnel and to document sampling activities, however EPA approval is not required. Solutia should proceed with sampling immediately. The supplemental information results (Addendum) are due by September 1, 2005.

In Solutia's Response to Comments, the proposed field work is generally consistent with EPA's request for supplemental information. However, some of the requested information was not specifically reiterated in the proposed field work. EPA clarifies that Solutia will also specifically obtain and provide the following information in the Addendum due September 1, 2005:

- The requested additional detail for the Route 3 Drum Site.
- A figure depicting monitoring wells sampled and analytical results for the Route 3 Drum Site.
- Well construction logs or screened intervals of the monitoring wells sampled at the Route 3 Drum Site.
- The bottom elevation of the Route 3 Drum Site trench.
- Whether soil sample locations near S0110 were adjusted in the field to ensure that fill is encountered.
- Total lead results for all six surficial soil samples obtained near S0110.
- Whether saturated conditions were encountered in deep sampling near LF-4.

Sediment Characterization

EPA will likely conduct a sediment sampling program in the Mississippi River to assess historical impacts. Validated results and a comparison to conservative screening values will be forwarded to Solutia.

Section 6.0, Groundwater Monitoring Plan

Final comments will be provided upon review of the Plume Stability Monitoring Plan to be submitted on July 5, 2005. For Monitoring Wells 15 and 16, determine the best locations and investigate whether another well can be added in this area to provide adequate coverage of contaminants that may still be discharging to the Mississippi River.

Solutia's Response to EPA Comments

EPA General Comment No. 2: EPA notes Solutia's response. However, in General Comment No. 18 of the November 18, 2004 letter, we noted that in order to approve the CMS Report, additional sampling to delineate the horizontal and vertical extent of dense, non-aqueous phase liquid (DNAPL) impacts in the source areas would be necessary. For example, the first round of DNAPL investigation at the facility (borings DNAPL K-1 through K-12) did not adequately delineate the extent of DNAPL impacts west of the Former Chlorobenzene Process Area. Thus, the intent of EPA's General Comment No. 2 in its May 4, 2005 letter was to indicate that kriging would be an acceptable tool to use in selecting additional focused locations for DNAPL investigations, subject to the additional qualifiers listed in the comment. Ensure that the revised CMS Report provides a complete investigation of source areas, including the Former Chlorobenzene Process Area.

EPA General Comment No. 4: Solutia's response indicates that soil samples collected to evaluate possible contaminant losses during homogenization will be analyzed for polychlorinated biphenyls (PCBs) by Aroclors (EPA Method 8082), while the response to General Comment No. 5 indicates that soil samples will be analyzed for PCB homologs (EPA Method 680). As noted in EPA's May 4, 2005 comment letter, all soil samples should be analyzed for PCB homologs, as this will permit a more accurate characterization of PCBs that have weathered while in situ.

EPA Specific Comment No. 2: Solutia's response to EPA's comment is adequate. Given the stated level of confidence in the volume estimate (i.e., between 66 and 100 percent), it is appropriate to present the total volume of impacted soil as a range in the revised CMS Report, with associated cost estimates based on both probable and worst-case volumes. Include this approach in the revised CMS Report. This comment also applies to EPA's Specific Comment No. 4 (i.e., presentation of mass delineation values for the Former Chlorobenzene Process Area).

EPA Specific Comment No. 3: Solutia's response is not entirely accurate. Ensure that soil samples will be analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and extractable organic halides (EOX), in addition to PCBs by EPA Method 680.

EPA Specific Comment No. 6: In addition to the response provided in its May 27, 2005 letter, Solutia should include a more thorough discussion of the applicability of the proposed technologies to the different on-site hydrogeologic units in the revised CMS Report. In particular, the revised CMS Report should discuss how the greater percentage of fine soils, lower bulk hydraulic conductivities, presence of near-surface voids and underground utilities, and other characteristics of the shallow hydrogeologic unit (SHU) may affect the selection of a technology for this unit, in contrast to selection of a technology for the middle hydrogeologic unit (MHU) and the deep hydrogeologic unit (DHU).

EPA Specific Comment No. 7: Solutia's proposal to use laboratory deionized (DI) water modified with nutrients and bicarbonate for the enhanced aerobic bioremediation bench-scale

tests is acceptable, with the understanding that the results derived from these tests may represent an upper limit on the amount of contaminant mass transfer the system is capable of sustaining from the soil matrix into the aqueous phase. More specifically, the use of modified DI water will not simulate the effects on overall mass transfer of contaminant loading in the influent groundwater entering the treatment zone. Any planning for subsequent field pilot-scale tests would need to consider mass potentially present in the aqueous phase (i.e., pore water and influent groundwater) when calculating required dosages of gaseous oxygen or other oxygen-donating reagents.

Solutia's proposal to add plate count analyses for pre-treatment and post-treatment soil samples is acceptable. However, it is not obvious how Solutia intends to control the dosing of total organic carbon (TOC) and nutrients to the test sample if it will not analyze these parameters in the influent and effluent. Even if Solutia intends to spike the test volume with known amounts of TOC and nutrients, the effluent concentrations should be measured to determine any losses that are occurring within the system due to consumption of TOC and nutrients by the microorganisms. The effluent from the control (killed) sample should also be analyzed to determine other (abiotic) losses within the system, if any.

In its response, Solutia asserted that a range of dissolved oxygen (DO) concentrations of between 10 milligrams per liter (mg/l) and 20 mg/l would be "more than adequate to support aerobic biodegradation of mono-chlorobenzene (MCB) and di-chlorobenzenes (DCBs) that dissolve from the DNAPL on the aquifer matrix." No justification for these assumed DO concentrations is provided. Provide appropriate justification for this assumption either by citing appropriate technical literature or providing calculations based on known conditions at the facility.

EPA Specific Comment No. 10: Solutia states that the proposed screen intervals for the new plume monitoring well network were derived from a model, and the results were erroneous because the bedrock surface elevation data were not entered into the model. The response also states that Solutia will revise the model to include the bedrock surface. Rather than numerical models, Solutia should consider the numerous soil boring logs and historical groundwater analytical data for selecting screen intervals.

EPA Specific Comment No. 11: The response states that "as long as MCB and DCB concentrations continue to decrease, it is not necessary to know the specific natural attenuation processes, either biotic or abiotic, that resulted in the observed reductions." If the biodegradation processes expected to occur through aerobic pathways will result in constituents of concern in groundwater, it will be necessary to monitor those constituents as well as MCB and DCB concentrations. Concentrations of daughter products also may lend information to: 1) confirm that concentration decreases are due to biotic and not abiotic processes; and 2) aid in evaluation of mass balances, to confirm principal contaminant destruction.

Solutia's response that it will investigate the possibility of detecting and quantifying suspected degradation products is acceptable. However, if EPA Methods 8260B and 8270C are not adequate for this objective, Solutia should evaluate alternate test methods, if available, to detect the daughter compounds.

EPA Specific Comment No. 13: Solutia has adequately addressed the portion of this comment regarding PCB delineation for purposes of the treatability study. However, full delineation of PCB contamination at the Former PCB Manufacturing Area will still be necessary prior to implementation of final remedies for the site. Address in the revised CMS Report, the complete delineation of the extent of PCB contamination.

Treatability Studies, General Comments

The objective of the treatability studies is to provide data to determine whether ISTD/enhanced aerobic bioremediation are viable remedial technologies to remove PCB and MCB/DCB contamination from the unsaturated zone and SHU. Therefore, provide the data quality objectives (DQOs) that specify the level of acceptable data uncertainty and define the percent removal that will be considered a "successful" demonstration.

The dates of the laboratory standard operating procedures (SOPs) included in the work plan range from 1999 to 2004. To ensure compatibility with most current standard procedures, Solutia should use SOPs that are no older than one year, unless the laboratories can justify using older versions.

In-Situ Thermal Desorption Work Plan

Section 1.0, page 1-2: The following statement is made:

"These bench-scale treatability tests are designed to provide a yes/no answer as to whether or not it is technically feasible to remove contaminant mass in the Former PCB Manufacturing Area and the Former Chlorobenzene Process Area."

The objective of bench-scale testing is not only to determine technical feasibility, but also to evaluate the potential performance of applicable technologies and generate data for scale up to a field pilot test of the most favorable technology or technologies. Bench-scale tests have significant inherent limitations, and thus are usually inadequate to form the sole basis for a yes/no decision on the technical feasibility of a technology. Therefore, Solutia should modify the language in this section to include the additional objectives for the bench-scale tests as stated herein.

Section 2.2, page 2-3: The work plan states that sampling collection will not be performed until EPA approves the selected sampling locations. EPA approval of the proposed sampling locations is not required. Solutia should immediately collect soil samples at former sample location S0825 and begin the bench-scale treatability test program.

Section 2.3, Soil Sample Collection: The description of sampling procedures in this section does not discuss how possible variations in soil characteristics will be addressed. The collection of approximately six gallons of soil, as dictated by the bench-scale test requirements, is likely to produce soil from varying depths and strata, and the risk that each one-gallon container may contain soil with appreciably different characteristics (whereas the intent is for each sample to be representative of the same soil type, depth, and contaminant concentrations). It is understood that homogenization of six gallons of soil (approximately 66 pounds) may be impracticable to accomplish in the field, and further that homogenization in the field combined with the homogenization that will occur upon receipt at the laboratory (refer to Section 2.4.2 of the Work Plan) may produce unacceptably high losses of VOCs. Nonetheless, the field personnel should make an effort to ensure uniformity between the different one-gallon sample aliquots, perhaps by

placing some of the soil from each visually identifiable stratum into each of the six, one-gallon containers. Ensure that uniformity of soil characteristics among the six, one-gallon aliquots for the bench-scale tests is achieved, as practicable. This comment also applies to Section 2.3 of the Enhanced Aerobic Bioremediation Work Plan.

Section 2.4.1, Treatability Test Objective and Approach: This section states that three sample aliquots from the Former PCB Manufacturing Area will be submitted for ISTD bench-scale tests, at target temperatures of 300 degrees Celsius (deg C), 350 deg C, and 425 deg C. No rationale is provided for these specific target temperatures. When the Terra-Therm, Inc. (TTI), ISTD technology was utilized at the Missouri Electric Works Site (Cape Girardeau, Missouri) for remediation of PCBs in soil, it achieved in-situ temperatures of approximately 900 degrees Fahrenheit (deg F) (482 deg C) at the coolest locations in the treatment zone (i.e., points furthest from the heater-vacuum wells).¹ In contrast, when the TTI ISTD technology was applied at the U.S. Navy's Naval Facility Centerville Beach (Ferndale, California), the average temperature at the coolest locations in the treatment zone was only 675 deg F (357 C).² Provide the rationale for selection of these target temperatures for the bench-scale tests in this section, including data on boiling points for the PCB homologs expected to be present in the Former PCB Manufacturing Area.

This section states that air will be passed through the test cylinder containing the soil sample during heating, to simulate the vacuum extraction component of the ISTD treatment process. However, the air flow rate (or range of flow rates) to be used is not specified. The flow rate(s) should, to the extent possible, be similar to the flow that an equivalent cross-section of soil would receive in-situ during a field pilot-scale test. Provide additional information on the air flow rates that will be used during the bench-scale tests (or the calculation procedure that will be used to derive the estimated air flow rates). This same comment also applies for the treatability tests conducted on unsaturated and saturated contaminated soil from the Former Chlorobenzene Process Area (Section 3.4.3 of the Work Plan).

Section 2.4.2, page 2-6: The work plan states that EPA approval of representativeness of PCB concentrations and adequate homogenization is required before proceeding. EPA approval is not required. Solutia should ensure that the PCB concentrations are significant enough and homogenization complete for appropriate treatability testing. Solutia may consult with EPA to discuss the results and problems encountered but Solutia is required to implement the treatability testing program appropriately and in a timely manner.

¹Vinegar, H.J., E.P. de Rouffignac, R.L. Rosen, G.L. Stegmeier, M.M. Bonn, D.M. Conley, S.H. Phillips, J.M. Hirsch, F.G. Carl, J.R. Steed, D.H. Arrington, P.T. Brunette, W.M. Mueller, and T.E. Siedhoff, "In-Situ Thermal Desorption of PCBs," presented at the HazWaste/World Superfund XVIII Conference, Washington, DC, December 1997.

²Conley, D.M. and C.M. Lonie, "Field Scale Implementation of In-Situ Thermal Desorption Thermal Well Technology," Soil Heating Technologies, p. 175.

Section 2.4.3, page 2-7: Based on an expected total project duration of 90 days, the treatability study report is due to EPA no later than September 23, 2005. As discussed in the comment on Section 1.0, the treatability study report should include a discussion of the technical feasibility and evaluation of the potential performance of applicable technologies to remove contaminant mass in the Former PCB Manufacturing Area and the Former Chlorobenzene Process Area, and evaluate the data for scale up to a field pilot test of the most favorable technology or technologies. A meeting should also be held by October 7, 2005, to discuss the treatability results and path forward.

Section 3.1.1, Thermal Treatment: The following statement is made:

“At sites with MCB/DCB in source area soils, soil moisture would have to be boiled off before volatilization of MCB and DCB could occur.”

While the above statement is technically correct, it is also somewhat misleading. A TTI representative has indicated that, based on a field pilot-scale test at the Eastland Woolen Mill (Corinna, Maine), the primary mechanism for removal of MCB using the ISTD technology appears to be steam distillation, rather than direct volatilization.³ This is important, because it suggests that considerable mass removal of MCB may occur even at temperatures below its boiling point (132 deg C).

Section 3.2, pages 3-3 and 3-4: The work plan states that sampling collection will not be performed until EPA approves the selected sampling locations. EPA approval of the proposed sampling locations is not required. Solutia should immediately collect soil samples at former sample locations DNAPL-K-4 and SCT-B67 and begin the bench-scale treatability test program.

Section 3.4.2, page 3-5: The work plan states that EPA approval of representativeness of “PCB” (the text should read “MCB/DCB”) concentrations and adequate homogenization is required before proceeding. EPA approval is not required. Solutia should ensure that the MCB/DCB concentrations are significant enough and homogenization complete for appropriate treatability testing. Solutia may consult with EPA to discuss the results and problems encountered but Solutia is required to implement the treatability testing program appropriately and in a timely manner. This comment applies to both unsaturated and saturated soil samples.

Section 3.4.3, page 3-7: See comment above on Section 2.4.3.

Section 3.4.3, Treatability Test: Solutia’s proposal to bench test the saturated soil sample from the SHU at only one target temperature of 100 deg C is unacceptable, because it: 1) may not simulate actual field conditions; and 2) does not allow for investigation of the upper range of temperatures that could potentially be achieved in situ.

As stated in EPA’s May 4, 2005 technical comments, TTI has indicated that the expected range

³Baker, R.S., Terra-Therm, Inc., Personal Communication, February 23, 2005.

of hydraulic conductivities in the silty upper portion of the SHU (where the majority of DNAPL is located) should not pose a significant barrier to the technology's ability to drive off soil moisture. A bench-scale test at 100 deg C may mimic conditions at the treatment zone boundaries, but the bench testing program should also include simulation of conditions closer to the center of the zone, where the MCB/DCB concentrations are highest and the probable presence of DNAPLs has been noted. The siltier, less permeable soils within the SHU are expected to reduce the flux of incoming groundwater into the middle of the impacted area, allowing the heater vacuum wells to evaporate most of the pore water and thus achieve higher average temperatures in the bulk soil matrix. Confining the bench-scale tests to modeling behavior at the system boundaries equates to an incomplete and excessively conservative testing program. Furthermore, techniques such as steam injection upgradient from the treatment zone may be considered as a means for limiting groundwater influx.⁴

Revise the treatability test procedures, as follows:

- Run one test at 100 deg C, for 72 hours
- Attempt to run a test at 132 deg C (or whatever maximum temperature above 100 deg C can be attained within the test cylinder, as measured by the thermocouple, for 72 hours)
- If the test system can successfully attain 132 deg C in the cylinder, attempt to run a test at 200 deg C (or whatever maximum temperature above 132 deg C can be attained for 72 hours).

Appendix C, Section 3.1: As discussed above, this section of the Field Sampling Plan (FSP) should be modified to specify that enough soil from the saturated portion of the SHU will be collected to perform three bench-scale tests, at three different temperatures. This would equate to approximately six gallons of soil, rather than the four gallons specified in FSP.

Appendix C, Section 4.2: For clarification, tabulate the number and types of QC samples (i.e., equipment blanks, trip blanks, matrix spike/matrix spike duplicates [MS/MSD], and field duplicates) to be analyzed during treatability testing. Alternatively, this information may be included in Table 1.

Appendix C, Section 4.4: For clarification, state whether investigation derived wastes (IDW) will be analyzed prior to disposal using the same sample analytical methods or for potential characteristics of hazardous waste (40 CFR 261, Subpart C).

Appendix C, Section 4.8: Specify the percentage of data from the total sample set that will be validated for the field and laboratory operations.

⁴Baker, R.S. and G. Heron, "In-Situ Delivery of Heat by Thermal Conduction and Steam Injection for Improved DNAPL Remediation," www.terratherm.com.

Appendix C, Section 4.8.2: Solutia should make the following revisions to the FSP:

- To insure sufficient data quality, specify corrective actions if and when discrepancies are noted during the ten percent raw data calculations and compound identification checks.
- Clarify the statements that data validation will be performed using method or laboratory control limits (i.e., it is not clear whether the QC parameter is supposed to meet one or both method and laboratory-generated control limits to pass).
- Clarify the statement that any control limits outside the acceptable range shall be identified and reported.
- If PCB analysis will be performed using EPA Method 680, the list of QA/QC parameters to be checked should include gas chromatography/mass spectrometer (GC/MS) tuning criteria. Also delete confirmation analysis, as this is not applicable for MS analysis.
- All references to inductively coupled plasma (ICP)-related QA/QC performance parameters should be deleted if EPA Method 9023 will be used for EOX analysis.

Appendix C, Table 2: Footnote 1 to this table states that soil sample aliquots for VOC analysis may be preserved by freezing them in water, in lieu of chemical preservation using sodium bisulfate or methanol. EPA Method 5035 does not mention freezing in water as an allowable option for limiting VOC losses from the sample. Solutia should provide the rationale for suggesting this method of preservation.

Correct EPA Reference Method 8206B to 8260B.

Enhanced Aerobic Bioremediation Work Plan

Section 1.0, page 1-2: The work plan includes a discussion of PCBs at the Former PCB Manufacturing Area and the unsaturated zone. It is our understanding that the enhanced aerobic bioremediation treatability tests will be performed only to determine if it is technically feasible to remove contaminant mass at the Former Chlorobenzene Process Area in saturated zones within the SHU, MHU, and DHU.

Section 2.1.3, Enhanced Aerobic Bioremediation: This section states that according to studies by Van der Meer (1991), complete mineralization of chlorobenzene is possible through aerobic bioremediation pathways. No reference information is supplied, and the paper(s) is not included in Appendix C of the Work Plan. Provide the reference information or copies of the articles to EPA.

Section 2.2, page 2-5: Target depth at sample location DNAPL-K-4 is stated to be 14.5 to 18.5 ft. bgs. Table 1 of the Field Sampling Plan (FSP) in Appendix E proposes an estimated sample depth of 15 to 19 ft. bgs. Ensure that the proposed sample depth in the FSP is consistent with the work plan text.

The work plan states that sampling collection will not be performed until EPA approves the selected sampling location(s). EPA approval of the proposed sampling locations is not required. EPA notes that for the saturated MHU/DHU soil treatability test sample, the sample location is at DNAPL-K-3 (not DNAPL-K-4). Solutia should immediately collect soil samples at former sample locations DNAPL-K-3 and DNAPL-K-4 and begin the bench-scale treatability test program.

Section 2.4.2, pages 2-7 and 2-8: Treatability test soils are not proposed to be characterized for PCBs but in Section 3.3 of the FSP, PCBs are part of the proposed soil sample analysis. In Table 2 of the FSP, PCBs are not a proposed parameter group. Ensure that the FSP is consistent with the work plan text.

The work plan states that EPA approval of representativeness of MCB/DCB concentrations and adequate homogenization is required before proceeding. EPA approval is not required. Solutia should ensure that the MCB/DCB concentrations are significant enough and homogenization complete for appropriate treatability testing. Solutia may consult with EPA to discuss the results and problems encountered but Solutia is required to implement the treatability testing program appropriately and in a timely manner.

Section 2.4.3, Treatability Test: From inspection of the embedded table "MCB/DCB DNAPL Treatability Test Effluent Sampling Schedule", some potential inaccuracies were noted. It is assumed that the first two samples, collected during equilibration of the test columns, are denoted as being collected during Week (-1) and Week 0. If this assumption is correct, the number of samples indicated for Microcosms 2 and 3 are inaccurate, specifically one sample too many. The final sample for Microcosm 2 should be collected during Week 4, and the final sample for Microcosm 3 should be collected during Week 6. Review this table and make any

required modifications to match the text presented in this section.

The Work Plan states on page 2-11:

“Because aerobic activity may result in the complete utilization of oxygen prior to column effluent, MCB/DCB-degrading activity in anoxic conditions may occur and be quantifiable.”

Earlier on this same page, the work plan states that pH, redox potential, and DO will be periodically measured using probes (the frequency of measurement is not indicated). Thus, from the information provided, it unclear how Solutia will determine when the test columns have transitioned from aerobic to anoxic conditions, and further how the amount of biodegradation occurring under anoxic conditions will be quantified (e.g., decrease in nitrates or other method). Provide additional detail on how MCB/DCB degradation will be quantified under anoxic conditions.

Section 2.4.3, page 2-12: Based on an expected total project duration of 180 days, the treatability study report is due to EPA no later than December 23, 2005. As discussed in the comment on Section 1.0 of the ISTD Work Plan, the treatability study report should include a discussion of the technical feasibility and evaluation of the potential performance of applicable technologies to remove contaminant mass in the Former Chlorobenzene Process Area, and evaluate the data for scale up to a field pilot test of the most favorable technology or technologies.